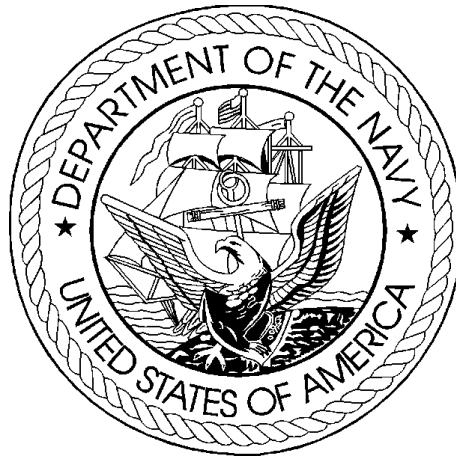


DEPARTMENT OF THE NAVY  
FISCAL YEAR (FY) 2011  
BUDGET ESTIMATES



JUSTIFICATION OF ESTIMATES  
FEBRUARY 2010

RESEARCH, DEVELOPMENT, TEST & EVALUATION,  
NAVY  
BUDGET ACTIVITY 1-3

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## **Department of Defense Appropriations Act, 2011**

---

### **Research, Development, Test and Evaluation, Navy**

For expenses necessary for basic and applied scientific research, development, test and evaluation, including maintenance, rehabilitation, lease, and operation of facilities and equipment, \$17,693,496,000, to remain available for obligation until September 30, 2012.

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Department of the Navy  
 FY 2011 President's Budget  
 Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request  
 Summary  
 (Dollars in Thousands)

19 Jan 2010

Summary Recap of Budget Activities -----	FY 2009 (Base & OCO) -----	FY 2010 Base & OCO Enacted -----	FY 2010 Supplemental Request -----	FY 2010 Total -----	FY 2011 Base -----	FY 2011 OCO -----	FY 2011 Total Request -----
Basic Research	525,075	549,354		549,354	556,425		556,425
Total Research, Development, Test & Eval, Navy	525,075	549,354		549,354	556,425		556,425
Summary Recap of FYDP Programs -----							
Research and Development	525,075	549,354		549,354	556,425		556,425
Total Research, Development, Test & Eval, Navy	525,075	549,354		549,354	556,425		556,425

## UNCLASSIFIED

Department of the Navy  
 FY 2011 President's Budget  
 Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request  
 (Dollars in Thousands)

Appropriation: 1319N Research, Development, Test &amp; Eval, Navy

Date: 19 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
--	-----	----	---	-----	-----	-----	-----	-----	-----	-----	-
1	0601103N	University Research Initiatives	01	102,411	102,246		102,246	108,679		108,679	U
2	0601152N	In-House Laboratory Independent Research	01	17,103	18,001		18,001	17,979		17,979	U
3	0601153N	Defense Research Sciences	01	405,561	429,107		429,107	429,767		429,767	U
		Basic Research		525,075	549,354		549,354	556,425		556,425	
				-----	-----	-----	-----	-----	-----	-----	
		Total Research, Development, Test & Eval, Navy		525,075	549,354		549,354	556,425		556,425	



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Department of the Navy  
 FY 2011 President's Budget  
 Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request  
 Summary  
 (Dollars in Thousands)

19 Jan 2010

Summary Recap of Budget Activities -----	FY 2009 (Base & OCO) -----	FY 2010 Base & OCO Enacted -----	FY 2010 Supplemental Request -----	FY 2010 Total -----	FY 2011 Base -----	FY 2011 OCO -----	FY 2011 Total Request -----
Applied Research	775,483	718,810		718,810	678,680		678,680
Total Research, Development, Test & Eval, Navy	775,483	718,810		718,810	678,680		678,680
Summary Recap of FYDP Programs -----							
Research and Development	775,483	718,810		718,810	678,680		678,680
Total Research, Development, Test & Eval, Navy	775,483	718,810		718,810	678,680		678,680

## UNCLASSIFIED

Department of the Navy  
FY 2011 President's Budget  
Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request  
(Dollars in Thousands)

Appropriation: 1319N Research, Development, Test &amp; Eval, Navy

Date: 19 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
--	-----	----	---	-----	-----	-----	-----	-----	-----	-----	-
4	0602114N	Power Projection Applied Research	02	101,584	77,210		77,210	98,150		98,150	U
5	0602123N	Force Protection Applied Research	02	186,628	146,045		146,045	107,448		107,448	U
6	0602131M	Marine Corps Landing Force Technology	02	43,499	45,607		45,607	43,776		43,776	U
7	0602234N	Materials, Electronics and Computer Technology	02	7,280	2,788		2,788				U
8	0602235N	Common Picture Applied Research	02	89,673	90,440		90,440	70,168		70,168	U
9	0602236N	Warfighter Sustainment Applied Research	02	114,262	118,783		118,783	113,724		113,724	U
10	0602271N	Electromagnetic Systems Applied Research	02	61,439	69,327		69,327	83,902		83,902	U
11	0602435N	Ocean Warfighting Environment Applied Research	02	51,855	53,727		53,727	49,491		49,491	U
12	0602651M	Joint Non-Lethal Weapons Applied Research	02	4,795	5,983		5,983	6,002		6,002	U
13	0602747N	Undersea Warfare Applied Research	02	61,413	65,003		65,003	69,186		69,186	U
14	0602782N	Mine and Expeditionary Warfare Applied Research	02	53,055	43,897		43,897	36,833		36,833	U
		Applied Research		775,483	718,810		718,810	678,680		678,680	
				775,483	718,810		718,810	678,680		678,680	
Total Research, Development, Test & Eval, Navy				775,483	718,810		718,810	678,680		678,680	

Exhibit R-1G: FY 2011 President's Budget (Published), as of January 19, 2010 at 15:29:36

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Department of the Navy  
 FY 2011 President's Budget  
 Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request  
 Summary  
 (Dollars in Thousands)

19 Jan 2010

Summary Recap of Budget Activities -----	FY 2009 (Base & OCO) -----	FY 2010 Base & OCO Enacted -----	FY 2010 Supplemental Request -----	FY 2010 Total -----	FY 2011 Base -----	FY 2011 OCO -----	FY 2011 Total Request -----
Advanced Technology Development	820,702	831,923		831,923	725,599	14,100	739,699
Total Research, Development, Test & Eval, Navy	820,702	831,923		831,923	725,599	14,100	739,699
 Summary Recap of FYDP Programs -----							
Research and Development	820,702	831,923		831,923	725,599	14,100	739,699
Total Research, Development, Test & Eval, Navy	820,702	831,923		831,923	725,599	14,100	739,699

## UNCLASSIFIED

Department of the Navy  
FY 2011 President's Budget  
Exhibit R-1 FY 2011 Base and Overseas Contingency Operations (OCO) Request  
(Dollars in Thousands)

Appropriation: 1319N Research, Development, Test &amp; Eval, Navy

Date: 19 Jan 2010

Line No	Program Element Number	Item	Act	FY 2009 (Base & OCO)	FY 2010 Base & OCO Enacted	FY 2010 Supplemental Request	FY 2010 Total	FY 2011 Base	FY 2011 OCO	FY 2011 Total Request	S e c
--	-----	----	---	-----	-----	-----	-----	-----	-----	-----	-
15	0603114N	Power Projection Advanced Technology	03	96,837	116,191		116,191	117,908		117,908	U
16	0603123N	Force Protection Advanced Technology	03	121,465	92,962		92,962	61,877		61,877	U
17	0603235N	Common Picture Advanced Technology	03	86,583	104,531		104,531	96,720		96,720	U
18	0603236N	Warfighter Sustainment Advanced Technology	03	110,904	92,864		92,864	98,261		98,261	U
19	0603271N	Electromagnetic Systems Advanced Technology	03	56,092	75,506		75,506	82,143	14,100	96,243	U
20	0603640M	USMC Advanced Technology Demonstration (ATD)	03	102,534	129,962		129,962	115,089		115,089	U
21	0603651M	Joint Non-Lethal Weapons Technology Development	03	13,475	11,749		11,749	11,131		11,131	U
22	0603729N	Warfighter Protection Advanced Technology	03	52,711	51,893		51,893	18,076		18,076	U
23	0603747N	Undersea Warfare Advanced Technology	03	80,323	73,636		73,636	49,276		49,276	U
24	0603758N	Navy Warfighting Experiments and Demonstrations	03	65,208	52,373		52,373	53,177		53,177	U
25	0603782N	Mine and Expeditionary Warfare Advanced Technology	03	34,570	30,256		30,256	21,941		21,941	U
		Advanced Technology Development		820,702	831,923		831,923	725,599	14,100	739,699	
		Total Research, Development, Test & Eval, Navy		820,702	831,923		831,923	725,599	14,100	739,699	

Exhibit R-1G: FY 2011 President's Budget (Published), as of January 19, 2010 at 15:30:59

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**Program Element Table of Contents (by Budget Activity then Line Item Number)**

***Budget Activity 01: Basic Research***

<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
01	01	0601103N	University Research Initiatives.....	1
02	01	0601152N	In-House Lab Independent Res.....	13
03	01	0601153N	Defense Research Sciences.....	35

***Budget Activity 02: Applied Research***

<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
04	02	0602114N	Power Proj Applied Research.....	95
05	02	0602123N	Force Protection Applied Res.....	119
06	02	0602131M	Marine Corps Lndg Force Tech.....	157
07	02	0602234N	Materials, Electr & Computer Tech.....	187
08	02	0602235N	Common Picture Applied Research.....	191
09	02	0602236N	Warfighter Sustainment Applied Res.....	237
10	02	0602271N	Electromagnetic Systems Applied Research.....	269

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**Navy • President's Budget FY 2011 • RDT&E Program**

***Budget Activity 02: Applied Research***

<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
11	02	0602435N	Ocean Wrfghtg Env Applied Res.....	315
12	02	0602651M	JT Non-Lethal Wpns Applied Res.....	337
13	02	0602747N	Undersea Warfare Applied Res.....	343
14	02	0602782N	Mine & Exp Warfare Applied Res.....	371

***Budget Activity 03: Advanced Technology Development (ATD)***

<b>Line Item</b>	<b>Budget Activity</b>	<b>Program Element Number</b>	<b>Program Element Title</b>	<b>Page</b>
15	03	0603114N	Power Projection Advanced Technology.....	389
16	03	0603123N	Force Protection Advanced Technology.....	405
17	03	0603235N	Common Picture Advanced Technology.....	433
18	03	0603236N	Warfighter Sustainment Advd Tech.....	459
19	03	0603271N	Electromagnetic Systems Advanced Technology.....	485
20	03	0603640M	MC Advanced Technology Demo.....	511
21	03	0603651M	JT Non-Lethal Wpns Tech Dev.....	551
22	03	0603729N	Warfighter Protection Adv Tech.....	559
23	03	0603747N	Undersea Warfare Advanced Tech.....	571

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*Budget Activity 03: Advanced Technology Development (ATD)*

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
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25	03	0603782N	Mine and Expeditionary Warfare Advanced Technology.....	603

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Navy • President's Budget FY 2011 • RDT&E Program

**Program Element Table of Contents (Alphabetically by Program Element Title)**

<b>Program Element Title</b>	<b>Program Element Number</b>	<b>Line Item</b>	<b>Budget Activity</b>	<b>Page</b>
Common Picture Advanced Technology	0603235N	17	03.....	433
Common Picture Applied Research	0602235N	08	02.....	191
Defense Research Sciences	0601153N	03	01.....	35
Electromagnetic Systems Advanced Technology	0603271N	19	03.....	485
Electromagnetic Systems Applied Research	0602271N	10	02.....	269
Force Protection Advanced Technology	0603123N	16	03.....	405
Force Protection Applied Res	0602123N	05	02.....	119
In-House Lab Independent Res	0601152N	02	01.....	13
JT Non-Lethal Wpns Applied Res	0602651M	12	02.....	337
JT Non-Lethal Wpns Tech Dev	0603651M	21	03.....	551
Marine Corps Lndg Force Tech	0602131M	06	02.....	157
Materials, Electr & Computer Tech	0602234N	07	02.....	187
MC Advanced Technology Demo	0603640M	20	03.....	511
Mine & Exp Warfare Applied Res	0602782N	14	02.....	371
Mine and Expeditionary Warfare Advanced Technology	0603782N	25	03.....	603
Navy Warfighting Exp & Demo	0603758N	24	03.....	591
Ocean Wrfghtg Env Applied Res	0602435N	11	02.....	315

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Navy • President's Budget FY 2011 • RDT&E Program

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Power Proj Applied Research	0602114N	04	02.....	95
Power Projection Advanced Technology	0603114N	15	03.....	389
Undersea Warfare Advanced Tech	0603747N	23	03.....	571
Undersea Warfare Applied Res	0602747N	13	02.....	343
University Research Initiatives	0601103N	01	01.....	1
Warfighter Protection Adv Tech	0603729N	22	03.....	559
Warfighter Sustainment Advd Tech	0603236N	18	03.....	459
Warfighter Sustainment Applied Res	0602236N	09	02.....	237

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				R-1 ITEM NOMENCLATURE PE 0601103N: <i>University Research Initiatives</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	102.411	102.246	108.679	0.000	108.679	113.157	121.996	121.109	123.650	Continuing	Continuing
0000: <i>University Research Initiatives</i>	95.430	99.059	108.679	0.000	108.679	113.157	121.996	121.109	123.650	Continuing	Continuing
9999: <i>Congressional Adds</i>	6.981	3.187	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	62.737
A. Mission Description and Budget Item Justification											
<p>This program includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that enable the U.S. Navy to maintain technological superiority, and for university research infrastructure to acquire research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary University Research Initiative (MURI) efforts involve teams of researchers investigating high priority topics and opportunities that intersect more than one traditional technical discipline. For many military problems this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results into Naval applications. The Defense University Research Instrumentation Program (DURIP) supports university research infrastructure essential to high quality Navy relevant research. The instrumentation program complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The program supports Presidential Early Career Awards for Scientists and Engineers (PECASE), single investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. This program provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		PE 0601103N: University Research Initiatives			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	108.612	99.472	0.000	0.000	0.000
Current President's Budget	102.411	102.246	108.679	0.000	108.679
Total Adjustments	-6.201	2.774	108.679	0.000	108.679
• Congressional General Reductions		-0.426			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		3.200			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-1.716	0.000			
• SBIR/STTR Transfer	-3.288	0.000			
• Program Adjustments	0.000	0.000	108.679	0.000	108.679
• Congressional Recision Adjustments	0.003	0.000	0.000	0.000	0.000
• Congressional Add Adjustments	-1.200	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds				FY 2009	FY 2010
Congressional Add: Center for Assured Critical Application and Infrastructure Security				0.000	1.195
Congressional Add: Ship Model Testing				0.000	1.992
Congressional Add: Human Neural Cell-Based Biosensor				0.997	0.000
Congressional Add: Low Acoustic and Thermal Signature Battlefield Power Source				1.994	0.000
Congressional Add: National Security Training				1.596	0.000
Congressional Add: Next Generation Automated Technology for Landmine Detection				1.596	0.000
Congressional Add: Radiation Hardness and Survivability of Electronic Systems				0.798	0.000
Congressional Add Subtotals for Project: 9999				6.981	3.187
Congressional Add Totals for all Projects				6.981	3.187

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>	R-1 ITEM NOMENCLATURE PE 0601103N: <i>University Research Initiatives</i>	
<p><b><u>Change Summary Explanation</u></b></p> <p>Technical: Not applicable.</p> <p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601103N: <i>University Research Initiatives</i>				<b>PROJECT</b> 0000: <i>University Research Initiatives</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>University Research Initiatives</i>	95.430	99.059	108.679	0.000	108.679	113.157	121.996	121.109	123.650	Continuing	Continuing

## **A. Mission Description and Budget Item Justification**

This project includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that are important for maintaining the technological superiority of the U.S. Navy and for university research infrastructure to acquire instrumentation needed to maintain and improve the quality of university research important to the Navy. MURI efforts involve teams of researchers investigating high priority topics that intersect more than one traditional technical discipline. For many military problems this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results into Naval applications. The DURIP project supports university research infrastructure essential to high quality Navy relevant research. The instrumentation project complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The PECASE project supports single-investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. This project provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.

## **B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM (DURIP)</b>  DURIP funds are provided to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator type research grants. Individual grants range from \$50K to \$1M. The DURIP program is an Office of the Secretary of Defense (OSD) interest item and OSD directs that funding for the DURIP efforts be awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. In turn, universities need to purchase the instrumentation and take delivery before any billings are generated. It frequently takes several months for delivery and billing to be completed.  The program decreases in FY 2010 and again in FY 2011 to allow for an increase in the MURI and	30.843	20.312	16.831	0.000	16.831

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601103N: University Research Initiatives		PROJECT 0000: University Research Initiatives		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
PECASE programs to accommodate OSD directed initiatives.  FY 2009 Accomplishments: - Conducted competition for 82 research instrumentation awards to universities.  Acquisition Workforce Fund: - Funded DoD Acquisition Workforce Fund.  FY 2010 Plans: - Conduct competition for research instrumentation awards to universities.  FY 2011 Base Plans: - Conduct competition for research instrumentation awards to universities.						
MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI)  Research efforts include high priority topics that intersect more than one traditional discipline. MURI topics are selected to address Naval Science and Technology (S&T) Focus Areas as described in the Naval S&T Strategic Plan. The MURI program is an OSD interest item and OSD directs that funding for the MURI efforts be awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. Since the MURI program funds academic researchers, execution of the efforts typically ramps up during the summer academic break months. MURI projects make significant contributions to Navy and DoD objectives by; speeding up scientific programs by cross-fertilization of ideas, hastening the transition of basic research to practical applications, and training students in cross-disciplinary approaches to science and engineering research of importance to DoD.  The increase from FY 2010 and out is due to OSD direction to increase peer-reviewed basic research in order to develop innovative solutions and to enhance the science and engineering		63.177	72.453	86.133	0.000	86.133

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601103N: University Research Initiatives		PROJECT 0000: University Research Initiatives		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
personnel base, accordingly, additional MURI awards will be made in FY 2010 and out.  FY 2009 Accomplishments: - Conducted competition for new MURI awards addressing selected high priority Naval S&T areas, transformational activities, and grand challenges, including strategically important DoD research areas. Six topics were identified for publication via Broad Agency Announcement (BAA) to solicit proposals. These topics addressed cyber security, science of autonomy, undersea biologics, electronic materials, human-computer interactions, and advanced training. - Continued MURI projects begun in prior years.  FY 2010 Plans: - Conduct competition for new MURI awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. Approximately seven high priority research topics will be identified for publication in a BAA to solicit proposals. - Continue MURI projects begun in prior years.  FY 2011 Base Plans: - Conduct competition for new MURI awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. Approximately seven high priority research topics will be identified for publication in a BAA to solicit proposals. - Continue MURI projects begun in prior years.						
PRESIDENTIAL EARLY CAREER AWARDS (PECASE)  PECASE awards are made to academic scientists early in their research career for extremely prestigious single-investigator research in areas of vital importance to the Navy. Awards provide national		1.410	6.294	5.715	0.000	5.715

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy				<b>DATE:</b> February 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601103N: <i>University Research Initiatives</i>		<b>PROJECT</b> 0000: <i>University Research Initiatives</i>		
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>						
		<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<p>recognition and research grants of up to \$200K per year for five years. OSD, with policy and oversight responsibility for the PECASE program, directed that the number of PECASE awards be increased to a maximum of 15 new awards per year. The funding increase from FY 2009 to FY 2010 reflects the fiscal impact of OSD's direction. An increase in the number of awards permits a larger number of these outstanding researchers to contribute to the DoN S&amp;T requirements.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"> <li>- Selected 9 outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy.</li> <li>- Continued PECASE programs begun in earlier years.</li> </ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"> <li>- Select 15 outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy.</li> <li>- Continue PECASE programs begun in earlier years.</li> </ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"> <li>- Select 15 outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy.</li> <li>- Continue PECASE programs begun in earlier years.</li> </ul>						
Accomplishments/Planned Programs Subtotals		95.430	99.059	108.679	0.000	108.679
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A						
<b>D. Acquisition Strategy</b> N/A						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103N: <i>University Research Initiatives</i>	<b>PROJECT</b> 0000: <i>University Research Initiatives</i>
<b>E. Performance Metrics</b> This University Research Initiative seeks to improve the quality of defense research conducted by universities and supports the education of engineers and scientists in disciplines critical to national defense needs. The initiative is a collection of specialized research programs performed by academic research institutions. Individual project metrics are tailored to the needs of specific applied research and advanced development programs. Example metrics include extending the life of Thermal Barrier Coatings for transition to the Enterprise and Platform Enablers Future Naval Capability program. It is projected that the life time of Thermal Barrier Coating on Turbine Blades can be doubled. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010															
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601103N: <i>University Research Initiatives</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>															
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>												
9999: <i>Congressional Adds</i>	6.981	3.187	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	62.737												
<p><b><u>A. Mission Description and Budget Item Justification</u></b>  This project shows Congressional Adds to this Program Element.</p> <p><b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b></p> <table border="1" style="width:100%; border-collapse: collapse; margin-top: 10px;"> <tr> <td style="width:60%;"></td> <td align="center" style="width:10%;"><b>FY 2009</b></td> <td align="center" style="width:10%;"><b>FY 2010</b></td> </tr> <tr> <td> Congressional Add: Center for Assured Critical Application and Infrastructure Security  <i>FY 2010 Plans:</i>  This effort supports Center for Assured Critical Application and Infrastructure Security research. </td> <td align="center">0.000</td> <td align="center">1.195</td> </tr> <tr> <td> Congressional Add: Ship Model Testing  <i>FY 2010 Plans:</i>  This effort supports Ship Model Testing research. </td> <td align="center">0.000</td> <td align="center">1.992</td> </tr> <tr> <td> Congressional Add: Human Neural Cell-Based Biosensor  <i>FY 2009 Accomplishments:</i>  This effort supported the investigation of human stem-cell derived neuronal cultures for use in a prototype biosensor that utilizes networks of mammalian neurons on microelectrode arrays as the sensor element for unknown toxicants and hazardous combinations of otherwise non-threatening compounds. A human neural progenitor population was generated that can be easily expanded and used to produce consistent human neural populations in vitro. Additionally, two dimensional networks were formed from the human neural progenitor-derived neurons in adherent culture on multi-electrode </td> <td align="center">0.997</td> <td align="center">0.000</td> </tr> </table>													<b>FY 2009</b>	<b>FY 2010</b>	Congressional Add: Center for Assured Critical Application and Infrastructure Security <i>FY 2010 Plans:</i> This effort supports Center for Assured Critical Application and Infrastructure Security research.	0.000	1.195	Congressional Add: Ship Model Testing <i>FY 2010 Plans:</i> This effort supports Ship Model Testing research.	0.000	1.992	Congressional Add: Human Neural Cell-Based Biosensor <i>FY 2009 Accomplishments:</i> This effort supported the investigation of human stem-cell derived neuronal cultures for use in a prototype biosensor that utilizes networks of mammalian neurons on microelectrode arrays as the sensor element for unknown toxicants and hazardous combinations of otherwise non-threatening compounds. A human neural progenitor population was generated that can be easily expanded and used to produce consistent human neural populations in vitro. Additionally, two dimensional networks were formed from the human neural progenitor-derived neurons in adherent culture on multi-electrode	0.997	0.000
	<b>FY 2009</b>	<b>FY 2010</b>																					
Congressional Add: Center for Assured Critical Application and Infrastructure Security <i>FY 2010 Plans:</i> This effort supports Center for Assured Critical Application and Infrastructure Security research.	0.000	1.195																					
Congressional Add: Ship Model Testing <i>FY 2010 Plans:</i> This effort supports Ship Model Testing research.	0.000	1.992																					
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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103N: <i>University Research Initiatives</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
arrays.		
Congressional Add: Low Acoustic and Thermal Signature Battlefield Power Source  <i>FY 2009 Accomplishments:</i> This effort developed a road map of fuel cell activities for portable fuel cell sources applications; worked in materials and modeling activities for the development of a porous stainless steel substrate with a palladium coating for hydrogen filtration; and fabrication techniques were explored to examine integration of the porous substrate with the remaining components of the fuel cell.	1.994	0.000
Congressional Add: National Security Training  <i>FY 2009 Accomplishments:</i> This effort supported enhancement of the number of eligible students seeking Defense Department national security positions by providing students with the credentials for these careers. Additionally, these students were exposed to public service careers in the S&T disciplines for the purpose of enhancing the future pool of talented applicants for DoD S&T professional positions.	1.596	0.000
Congressional Add: Next Generation Automated Technology for Landmine Detection  <i>FY 2009 Accomplishments:</i> Research was conducted into a novel approach for detecting landmines with a network of autonomous vehicles, which could speed up landmine clearing while keeping people safe.	1.596	0.000
Congressional Add: Radiation Hardness and Survivability of Electronic Systems	0.798	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103N: <i>University Research Initiatives</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>	
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>			
		<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort researched the development of novel electronic systems based on magnetic switching devices that promise significantly lower power requirements and increased radiation hardness compared to conventional microelectronic systems.			
Congressional Adds Subtotals		6.981	3.187
<b>C. Other Program Funding Summary (\$ in Millions)</b>			
N/A			
<b>D. Acquisition Strategy</b>			
N/A			
<b>E. Performance Metrics</b>			
This project shows Congressional Adds to this Program Element.			

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research				R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	17.103	18.001	17.979	0.000	17.979	18.579	18.623	19.051	19.451	Continuing	Continuing
0000: In-House Lab Independent Res	17.103	18.001	17.979	0.000	17.979	18.579	18.623	19.051	19.451	Continuing	Continuing
A. Mission Description and Budget Item Justification											
<p>This program element (PE) sustains U.S. Naval Science and Technology (S&amp;T) superiority by providing new technological concepts for the maintenance of naval power and national security and by helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNCs). The Department of Navy (DON) component responds to S&amp;T directions of the Naval S&amp;T Strategic Plan for long term Navy and Marine Corps improvements and is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command. It enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. The In-house Laboratory Independent Research (ILIR) program also adds increased emphasis to the revitalization of the scientist and engineer workforce component at the Navy's Warfare Centers and Laboratories by attracting superior candidates and retaining our best members through the provision of exciting and meaningful work.</p>											
<p>This PE addresses DON Basic Research which includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental, and life sciences; and is the core of Discovery and Invention. Basic research projects are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusters', which are consolidated in thirteen research focus areas: Power and Energy; Operational Environments; Maritime Domain Awareness; Asymmetric and Irregular Warfare; Information, Analysis and Communication; Power Projection; Assure Access and Hold at Risk; Distributed Operations; Naval Warfighter Performance and Protection; Survivability and Self-Defense; Platform Mobility; Fleet/Force Sustainment; Affordability, Maintainability and Reliability.</p>											
<p>This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for: basic research to support the execution of their assigned missions; developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems; promoting hiring and development of new scientists; and encouragement of collaboration with universities, private industry, and other Navy and Department of Defense laboratories.</p>											
<p>ILIR efforts are selected by Naval Warfare Centers/Lab Commanding Officers and Technical Directors near the start of each Fiscal Year through internal competition. Efforts typically last three years, and are generally designed to assess the promise of new lines of research. Successful efforts attract external, competitively awarded</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0601152N: In-House Lab Independent Res			
BA 1: Basic Research					
funding. Because the Warfare Centers and Labs encompass the full range of naval technology interests, the scope of ILIR topics roughly parallels that of PE 0601153N, Defense Research Science.					
Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	17.207	18.076	0.000	0.000	0.000
Current President's Budget	17.103	18.001	17.979	0.000	17.979
Total Adjustments	-0.104	-0.075	17.979	0.000	17.979
• Congressional General Reductions		-0.075			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		0.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.047	0.000			
• SBIR/STTR Transfer	-0.151	0.000			
• Program Adjustments	0.000	0.000	17.979	0.000	17.979
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601152N: <i>In-House Lab Independent Res</i>				<b>PROJECT</b> 0000: <i>In-House Lab Independent Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>In-House Lab Independent Res</i>	17.103	18.001	17.979	0.000	17.979	18.579	18.623	19.051	19.451	Continuing	Continuing
<b>A. Mission Description and Budget Item Justification</b> <p>This project sustains U.S. Naval S&amp;T superiority, provides new technological concepts for the maintenance of naval power and national security, and mitigates scientific surprises, while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNC's). It responds to S&amp;T directions of the Naval S&amp;T Strategic Plan for long term Navy and Marine Corps improvements. It is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command (NWDC) and the Marine Corps Combat Development Command (MCCDC), and enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities.</p> <p>This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for basic research to support the execution of their assigned missions, for developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to naval problems, to promote hiring and development of new scientists, and to encourage collaboration with universities, private industry, and other Navy and Department of Defense laboratories.</p>											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
ADVANCED MATERIALS						3.295	3.542	3.485	0.000	3.485	
Efforts include: structural materials; functional materials; maintenance reduction, hydrodynamics; power generation; energy conservation and conversion.  <i>FY 2009 Accomplishments:</i> - Continued research and development on energy flow control and redirection of anisotropic cylindrical shells. This research focuses on reduction and redirection of vibrational energy propagation through cylindrical structures by utilizing new anisotropic materials that are now available.											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued research and development effort to reinvestigate the nature of the Cathodic Delamination (CD) problem and determine the effectiveness of new approaches to combating the old scourge of CD on naval hardware.</li><li>- Continued research in the development of an algorithm that makes use of both forward and inverse modeling techniques to determine variations in the static and dynamic material properties of hyperelastic materials from experimental measurement. This research seeks to develop a technique that combines modeling and experimental measurements to quantify spatial variations in a material's response to static and dynamic loads.</li><li>- Continued research on mesoscale models to include dissipative particle dynamics and automata-based modeling strategies.</li><li>- Completed research to investigate a radical new technique for producing structures that have reconfigurable embedded functionality based on chemistry and nanotechnology. The research centers on the creation of a Micro Conduit Network (MCN) which is a series of interconnected micron-size channels designed to permeate though a structure and occupy the smallest volume fraction in order to preserve the strength and stiffness of the structure.</li><li>- Completed research to quantify the small angle X-ray scattering and tensile mechanical tests of the mechanical mechanism for protective response to different polyurea chemistries and characterized the response limits in terms of strain and high strain rates (10E-1s - 10E4/s) to ensure specific impact loading levels in the protective range of the polyurea coatings. The strain rate material response for both elastic and plastic were incorporated into the constitutive equation for modeling and hydrocode simulation for further calculations of the geometries and layer thickness.</li><li>- Completed research into conduction and electrical mechanisms through porous membranes for fuel cell membranes, chemical analysis and biological transport. The research revealed unusual and enhanced conduction properties in pores with widths less than 1um; exceeding the diameter by which the current theory predicts. This research will exploit the enhanced current where there exists the potential for order-of-magnitude improvements in sensors, computation and communications.</li><li>- Completed research from a previously sponsored ILIR project that produced the scientific foundation of a new technology for the epitaxial deposition of lattice-mismatched films on substrates of silicon (Si)</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and gallium arsenide (GaAs). This technology features the formation of an atomic layer or template that serves as an interface between the film and substrate. It was discovered that the layer formation happens when there is a chemical reaction between the substrate and the impinging molecules. This research focused on the hypothesis that instead of fusion, the impinging molecules come in sequence with a narrow distribution of velocities than ideal gas with lower entropy. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.						
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as complete above. - Complete research and development on energy flow control and redirection of anisotropic cylindrical shells. - Complete research and development effort on the nature of the CD problem for the Navy and determine the effectiveness of new approaches to combating CD on Naval hardware. - Complete research in the development of an algorithm that makes use of both forward and inverse modeling techniques to determine variations in static and dynamic material properties of hyperelastic materials from experimental measurement. - Complete research on mesoscale models to include dissipative particle dynamics and automata-based modeling strategies. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as complete above. - Complete FY 2009 initiated ILIR projects during FY 2011. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.						
ELECTRONICS SENSOR SCIENCES  Efforts include: sensing, diagnostics, and detectors; navigation and timekeeping; nano electronics; real time targeting, Electro Optical/InfraRed (EO/IR) electronics; EO/IR electronic warfare; and EO/IR sensors for surface and subsurface surveillance.  FY 2009 Accomplishments: - Continued research into the Space-Charge-Limited (SCL) transport of charge carriers across a potential difference. The related publications on theoretical, experimental and numerical investigations have undergone excess growth in the number of disciplines for which SCL related flows are found to be applicable. SCL is found to have a strong impact on ion diodes in connection with inertial fusion, cold cathode emission, field-emitter-arrays, and on the capabilities of photocathode guns. This research investigated the limitations of SCL transport and certain extensions that have recently been proposed which may lead to enhancements in the amount charge and ability to transport in 1-D, 2-D, and 3-D geometries. - Continued research into the twin concepts of post-selection of wave function in quantum mechanics and the Aharonov-Vaidman formula which has opened up new avenues in what can and cannot be measured in quantum mechanics. Each theory and experiment confirmation has proven new, previously unexpected effects in quantum mechanics and identifies a possible new area of technology.		2.458	2.608	2.562	0.000	2.562

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Research was conducted to translate the aspects of quantum mechanical models into a classical weak observable signature setting to determine if these effects can occur in electromagnetic and other wave theories. This research has the potential to provide: a new way to enhance signals that otherwise would not be detectable; new types of signatures to be looked for in the radar waveform returns; new phenomena - weak energy. Research was conducted to investigate these phenomena in the classical signals that are regularly used in Naval applications such as radar, sonar and electro-optics. - Completed research on new approaches to miniaturization and integration of optical components into compact functional systems capable of generating, localizing, detecting, amplifying, and processing light signals. This research focused on novel coupling and beam splitting methods utilizing metallic tip and multilayer stock. The beam splitting effect can be employed to construct a nanoplasmonic Y-splitter, the basic component in many optical devices. Nanoscale optics is expected to form the basis for future nanolithography, optical sensors, and diagnostics in the single-molecular level through surface Plasmon enhanced Ramon scattering. - Completed research using mid-IR solid state laser to photo-acoustically generate large dimension, short-lived underwater filaments. Filament dimensions on the order of 10 mm in diameter and 10 cm long with durations ranging from 100 microseconds to a few milliseconds are expected as a result of using an existing laser system. This research has the potential to produce large dimension filaments and accompanying controlled transient shock waves that may revolutionize air/surface-to-underwater communications and development of additional Naval applications to support situational awareness efforts. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility in Undersea Weaponry.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as complete above. - Complete research into the SCL transport of charge carriers across a potential difference. - Complete research into the twin concepts of post-selection of wave function in quantum mechanics and the Aharonov-Vaidman formula which has opened up new avenues in what can and cannot be measured in quantum mechanics. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility in Undersea Weaponry.						
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as complete above. - Complete FY 2009 initiated ILIR projects during FY 2011. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility in Undersea Weaponry.						
ENERGY SCIENCES  Efforts include: undersea weaponry; energetic materials and propulsion; directed energy; and TeraHertz Time-Domain Spectroscopy (THz-TDS) technology that addresses overseas contingency operations and Counter Improvised Explosive Device (C-IED) detection by detecting and spectroscopically identifying military and home-made explosives and formulations.		1.271	1.366	1.342	0.000	1.342

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued research to develop Computational Fluid Dynamic (CFD) modeling techniques to support flow optimization in diving, fire fighting, Chemical, Biological, Radiological, and Nuclear (CBRN) protection, and aeronautical and aerospace life support helmets. The goal of this research is to improve CO2 transport from life support helmets to optimize performance without resorting to an oral-nasal mask. - Continued research into the development of a theory that will describe vibrational energy transfer between a shock wave and the local vibrations/electrons of explosive molecules. The goal of this research is to provide a simplified theoretical expression for the rate of energy transfer into an explosive molecule, without lengthy molecular dynamics or quantum chemical calculations. The approach combines both macroscopic thermodynamic properties and ultra fast spectroscopy data to study the initial nanosecond a shock passes through the material. - Completed research on the physical properties of explosively driven, guided shock waves. An explosively driven, guided shock wave is a shock wave produced in a guide tube that was initiated by an explosion at one end of the tube. The goal of this project is explore the properties of guided shock waves to include the pressure, temperature, and velocity of the gas through which the guided shock wave travels. - Completed research in the THz-TDS technology which addressed overseas contingency operations and C-IED detection by detecting and spectroscopically identifying military and home-made explosives and formulations. The continued focus of this research is to establish peak assignments of explosives in the THz regime by comparing solid-state quantum chemistry calculations. Results of this study will provide the fundamental THz reflection and absorption spectra of explosives found in IEDs. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as complete above.</li><li>- Complete research to develop CFD modeling techniques to support flow optimization in diving, fire fighting, CBRN protection, and aeronautical and aerospace life support helmets. The goal of this research is to improve CO2 transport from life support helmets to optimize performance without resorting to an oral-nasal mask.</li><li>- Complete research to develop a theory to describe vibrational energy transfer between a shock wave and the local vibrations/electrons of explosive molecules. The goal of this research is to provide a simplified theoretical expression for the rate of energy transfer into an explosive molecule, without lengthy molecular dynamics or quantum chemical calculations.</li><li>- Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as complete above.</li><li>- Complete FY 2009 initiated ILIR projects during FY 2011.</li><li>- Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.</li></ul>						
HUMAN PERFORMANCE SCIENCES		2.036	2.183	2.147	0.000	2.147

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Efforts include: biosensors, biomaterial, bioprocesses; marine mammals; casualty care management, undersea medicine; human factors and organizational design; manpower, personnel and advanced cockpit; and operational training and education. These efforts are coordinated with the Navy Medical Research Center (NMRC).						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued research to improve the understanding of vection (visually induced illusion of self-motion) in relation to contact. The goal of this research is identify the threshold for vection as a function of stimulus and understand when a pilot is susceptible to disorientation due to vection in critical environment conditions.</li><li>- Continued research to examine whether or not various forms of visuospatial attention are a manifestation of a single cognitive process. The intent of this research is to understand the basic principles of visuospatial attention to allow engineers to define upper and lower boundaries for attentional ability and design display systems to consider these aspects of operator performance.</li><li>- Continued research into exhaled nitric oxide measurement to provide a reliable and sensitive noninvasive marker of pulmonary oxygen toxicity in humans. The research seeks to measure normal day-to-day individual variability in pulmonary function and exhaled nitric oxidant and contrast these measurements with pulmonary function, exhaled nitric oxide and pulmonary oxygen toxicity symptoms.</li><li>- Completed research to elucidate the pathogenic mechanism, looking for common and different underlying mechanisms of injury, in hyperbaric oxygen and Blast OverPressure (BOP) induced injury by specific induction of heme oxygenase-1 or specific suppression of inducible nitric oxide synthesis in lungs.</li><li>- Completed research to determine if inhaled heavy metals contribute to the pathogenesis of neurodegeneration. This research focused on the olfactory and trigeminal sensory nerves in the nasal mucosa. The hypothesis is that retrograde axonal transport of inhaled heavy metals from sensory nerves in the upper airway to the central nervous system results in significant neurotoxicity.</li><li>- Completed research in the proliferation and differentiation of adult/stem progenitor cells to mature, terminally differentiated cells of skin, muscle, bone, nerve, heart, tendon, liver, and pancreas in a</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
multi-step process. There is continual evidence that some tissue regenerative cells, particularly found in bone marrow migrate within the body and can contribute to healing at multiple sites in multiple lineages. Bone marrow-derived hematopoietic stem cells, mesenchymal stem cells, endothelial progenitor cells and skeletal muscle-derived stems can contribute to the regeneration of a variety of tissues in vivo. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.						
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as complete above. - Complete research in the area of understanding of vection in relation to contact. The goal of this research is identify the threshold for vection as a function of stimulus and understand when a pilot is susceptible to disorientation due to vection in critical environment conditions. - Complete research to examine whether or not various forms of visuospatial attention are a manifestation of a single cognitive process. - Complete research in the area of exhaled nitric oxide measurements to provide a reliable and sensitive noninvasive marker of pulmonary oxygen toxicity in humans. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601152N: In-House Lab Independent Res		PROJECT 0000: In-House Lab Independent Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as complete above. - Complete FY 2009 initiated ILIR projects during FY 2011. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.						
INFORMATION SCIENCES  Efforts include: mathematical foundation and computational theory and tools for design communications; decision support theory; algorithm and tools, information assurance, secure and reliable infrastructure for command and control; mathematical optimization for optimal resource allocation and usage; modeling and computational propagation; seamless, robust connectivity and networking and cyber warfare.  FY 2009 Accomplishments: - Continued research into the connection between graphs and commutative algebra, and construction of fast algorithms to compute interesting new invariants. This research will link graph theory, commutative algebra, geometry and topology to provide a new way to analyze data and information. - Continued research into recent advances in Commercial Off The Shelf (COTS) microprocessor performance that have largely been achieved via added parallelism (adding additional microprocessor "cores" on the system), rather than by the more familiar method of increasing the clock speed. Research into developing software to perform well on these parallel architectures is difficult and expensive. The problem has been made more difficult by the vastly different programming techniques required by the two leading COTS parallel architectures (IBM "Cell BE" vs Intel/AMD x86). Initiated an investigation into a technique to automatically apply a specialized Navy algorithm to these radically		2.052	2.208	2.172	0.000	2.172

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
different architectures, and use a stochastic search to optimize the performance of the algorithm to each targeted architecture. - Continued research to improve the methodology of time series summarization by utilizing the framework of second generation wavelets and on-off system models, and by inventing and utilizing better pre-processing strategies, segmentation algorithms, data transforms and dissimilarity functions. - Completed research to harness the power of clustering algorithms in association with other analytical techniques to detect changes in a system. This research focused on development of algorithms to compare different clustered data to find and measure changes in data using data clustering as an underlying representation of the data. - Completed research focused on the development of nonlinear dynamics based criteria to distinguish structural damage from general dynamic characteristic changes which include environmental effects. The goal of this research effort is to finalize the phased array interrogation/sensing signal extraction and nonlinear dynamic analysis schema to provide real-time health monitoring and diagnostic technology which has potential for a variety of applications. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.						
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as complete above. - Complete research into the connection between graphs and commutative algebra, and construction of fast algorithms to compute interesting new invariants. - Complete research into recent advances in COTS microprocessor performance that have largely been achieved via added parallelism (adding additional microprocessor "cores" on the system), rather than by the more familiar method of increasing the clock speed.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Complete research to improve the methodology of time series summarization by utilizing the framework of second generation wavelets and on-off system models, and by inventing and utilizing better pre-processing strategies, segmentation algorithms, data transforms and dissimilarity functions.</p> <p>- Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all efforts of FY 2010, less those noted as complete above.</p> <p>- Complete FY 2009 initiated ILIR projects during FY 2011.</p> <p>- Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.</p>						
NAVAL PLATFORM DESIGN SCIENCES		1.400	1.503	1.481	0.000	1.481
<p>Efforts include: novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>- Continued research in the area of experimental breaking wave loads by bringing the analysis into the computational realm using Reynolds Average Navier Stokes (RANS) codes. This research investigates four general phases: creating consistent, repeatable breaking waves; creating these waves so that they break on the surface to analyze impact forces; validating those impact forces with existing and additional experimental data; and exploring the scaling effects of the impact forces. The</p>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
goal of the research is to gain a much clearer understanding of the functional physics of breaking waves and the loads that are created, and to replicate these characteristics in a computational environment. This computational capability provided guidance for future fleet designs and improved understanding of hydro loads on structural ship design. - Continued research on a virtual shaping concept for structures and platforms. Virtual shaping is implemented by introducing a phase shift gradient in the reflective wave along a structural surface, which will cause the reflection of an incoming plane wave to be in a non-specular direction, minimizing the chance of detection by the emitter. The virtual shaping concept could be implemented by surface treatments, appliques containing micropatch arrays constructed to simulate the effects of shaping when applied to the ship structure. The goals of this research are to reduce the need for the tumblehome design for stealthiness, reduce surface area of topside structures, and development of a retrofitting process for existing ships to reduce their radar cross section. - Continued research to develop the next generation of prediction tools based on RANS such that arbitrary complex geometries, including non-circular body, can be handled and the reliance on empiricism can be minimized. The goal of this research is to be accurate and fast enough to do real time analysis, support submarine design, and be able to accommodate the submarine submerged operating envelope. - Completed research on the increasing sophistication of sensor systems that have made mid- and high-frequency acoustic signature identification possible. New ship classes are given tight acoustic budgets, driving the exploration of new and novel concepts in hull form, materials and propulsion and development of structural and acoustic analysis tools to evaluate the vulnerability. The focus of this research project was to develop a method for efficiently addressing a class of mid-frequency vibration problems highly relevant to Naval vessels. The goal was to capture directly the mid-frequency physics rather than apply a hybrid approach. - Completed research into ThermoElectric (TE) devices used for waste heat recovery and its conversion to electrical energy. Conversion efficiencies of the TE devices are related to a dimensionless figure of merit referred to as ZT. Devices have low efficiencies to due to a low value of ZT. The goal of this research was to provide an improved understanding of the physical and chemical					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
properties of a material that lead to an increase in the value of ZT and subsequently an increase in conversion efficiency. - Completed research to increase the energy density and lower the self-discharge rate of energy storage systems by identifying the physicochemical properties of the electrode/electrolyte interface associated with capacitance. Focus was on novel carbons and lithium electrolytic salts (as opposed to tetraethylammonium tetrafluoroborate used in current capacitors) and non-aqueous, asymmetric hybrid supercapacitors. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.						
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as completed above. - Complete research on breaking wave loads utilizing the computational RANS codes. The research will investigate four general phases: creating consistent, repeatable breaking waves; creating these waves so that they break on the surface to analyze impact forces; validating those impact forces with existing and additional experimental data; and exploring the scaling effects of the impact forces. - Complete research on a virtual shaping concept for structures and platforms. - Complete research to develop the next generation prediction tools based on RANS such that arbitrary complex geometries including non-circular body can be handled and the reliance on empiricism can be minimized. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.  FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Complete FY 2009 initiated ILIR projects during FY 2011. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.					
OCEAN/SPACE SCIENCES  Efforts include: Littoral Geosciences, Optics, and biology; Marine Mammals; Ocean Acoustics; and autonomous systems.  FY 2009 Accomplishments: - Continued Naval Research Enterprise Intern Program (NREIP) to support undergraduate and graduate students performing Navy-related research at Naval Warfare Centers under the supervision and mentorship of DON Scientists, thus exposing them to interesting and challenging work done at the centers. NREIP is a continuing Navy education program. - Continued research into the development of a pentacene based neutron detector. This effort will seek to explore processing parameters for preparing thick pentacene-based films at purities suitable for neutron detection and develop a fundamental understanding of the electronic structure and interaction of pentacene with organo-boron-containing film components. - Continued research into the phenomenon of Core-Valence Luminescence (CVL) in scintillators that have the potential for radiation discrimination. CVL is the emission resulting from radiative transitions	4.591	4.591	4.790	0.000	4.790

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
between the valance and first core band under gamma excitation. This research will explore unique spectral properties which can be exploited to discriminate between different types of nuclear radiation. - Continued research into the relative performance of Probabilistic Multi-Hypothesis Tracker (PMHT) and Joint Probabilistic Data Association (JPDA) and methods for integrating the best aspects of both into a single multi-target tracking and data fusion algorithm. This research will seek to integrate an Interacting Multiple Model (IMM) algorithm into the PMHT algorithm, with a Multi-Dimensional Assignment (MDA). - Continued research and development into a new scaleable Computational Fluid Dynamics (CFD) tool to simulate the propulsion and maneuvering hydrodynamics of a biominetic Autonomous Underwater Vehicles (AUV) employing multiple flapping foils as the primary propulsor and control surfaces. This research effort investigates CFD as a tool for; evaluating biominetic AUV designs, and development of control strategies for optimizing the hydrodynamic performance of biomimetic designs while minimizing undesirable effects (such as unwanted vehicle motions) that can degrade sensor performance. - Completed the development of test algorithms for acoustic marine mammals (Beaked Whales). Density data was analyzed for spatial, seasonal and diurnal trends, and the relationships to oceanographic features. Detection and localization archive files from marine mammal monitoring on Navy ranges at the Atlantic Undersea Test and Evaluation Center, Bahamas were incorporated. The results of the algorithms were required to meet proposed mitigation measures for both at sea operations and long term monitoring of the Navy's undersea acoustic ranges. - Completed research to determine whether chaos based communications can be applied to typical range tracking scenarios. Chaos based spread-spectrum communications to underwater telemetry have been explored, simulated and demonstrated for low-Doppler littoral environments. - Initiated ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects have gone through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 focused on supporting Naval Battlespace Awareness, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility initiatives in Ocean Acoustics and Undersea Weaponry.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund.						
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as completed above. - Complete research into the development of a pentacene based neutron detector. - Complete research into the phenomenon of CVL in scintillators that have the potential for radiation discrimination. - Complete research into the relative performance of PMHT and JPDA and methods for integrating the best aspects of both into a single multi-target tracking and data fusion algorithm. - Complete research and development into a new scalable CFD tool to simulate the propulsion and maneuvering hydrodynamics of a biominetic AUV employing multiple flapping foils as the primary propulsor and control surfaces. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility initiatives in Ocean Acoustics and Undersea Weaponry.						
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Complete FY 2009 initiated ILIR projects during FY 2011. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2011 will focus on supporting Naval Battlespace Awareness, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility initiatives in Ocean Acoustics and Undersea Weaponry.						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy				<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601152N: <i>In-House Lab Independent Res</i>	<b>PROJECT</b> 0000: <i>In-House Lab Independent Res</i>						
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>								
				<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
Accomplishments/Planned Programs Subtotals				17.103	18.001	17.979	0.000	17.979
<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>								
N/A								
<b><u>D. Acquisition Strategy</u></b>								
N/A								
<b><u>E. Performance Metrics</u></b>								
<p>The ILIR initiative seeks to improve the quality of defense research conducted predominantly through the Naval Warfare Centers/Laboratories. It also supports the development of technical intellect and education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in a military laboratory environment. Initial research focus is often conducted in an unfettered environment since it is basic research, but many projects focus on applying recently developed theoretical knowledge to real world military problems with the intention of developing new capabilities and improving the performance of existing systems. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.</p>								

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>	<b>DATE:</b> February 2010
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<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>							
1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				PE 0601153N: <i>Defense Research Sciences</i>							
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
Total Program Element	405.561	429.107	429.767	0.000	429.767	443.593	466.118	480.310	503.304	Continuing	Continuing
0000: <i>Defense Research Sciences</i>	385.515	412.019	429.767	0.000	429.767	443.593	466.118	480.310	503.304	Continuing	Continuing
9999: <i>Congressional Adds</i>	20.046	17.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	103.295

**A. Mission Description and Budget Item Justification**

This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise. It is based on investment directions as defined in the Naval Science & Technology Strategy approved by the S&T Corporate Board (Feb 2009). This new strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs).

This PE addresses basic research efforts including scientific study and experimentation directed toward increasing knowledge and understanding in national security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research on the order of a hundred technology and capability-related 'thrusts', which are consolidated into about fifteen research areas. These in turn support the major research areas of the Navy and Marine Corps: Autonomous Systems; Command, Control, Communications and Computers (C4); Countermeasures and Counterweapons; Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support (Education and Outreach).

S&T investment in basic research also includes the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend. There are currently four NNRs.

S&T investment in basic research also includes the Basic Research Challenge program which was established to competitively select and fund promising research programs in new areas not addressed by the current basic research program. The Basic Research Challenge Program stimulates new, high-risk basic research projects in multi-disciplinary and departmental collaborative efforts, and funds topics that foster leading edge science and attract new principal investigators and organizations. Basic Research Challenge awards are for a period of four years.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0601153N: Defense Research Sciences			
BA 1: Basic Research					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	419.939	413.743	0.000	0.000	0.000
Current President's Budget	405.561	429.107	429.767	0.000	429.767
Total Adjustments	-14.378	15.364	429.767	0.000	429.767
• Congressional General Reductions		-1.788			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.008			
• Congressional Adds		17.160			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-8.055	0.000			
• SBIR/STTR Transfer	-7.520	0.000			
• Program Adjustments	0.000	0.000	429.767	0.000	429.767
• Congressional Recision Adjustments	-0.003	0.000	0.000	0.000	0.000
• Congressional Add Adjustments	1.200	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment					
Congressional Add: Energetics S&T Worforce Development					
Congressional Add: Human Neural Cell-Based Biosensor					
Congressional Add: Next Generation; Manufacturing Processes and Systems					
Congressional Add: ONAMI Nanoelctronics, Nanometrology and Nanobiotechnologoy Initiative					
Congressional Add: Shock and Vibration Modeling of Marine Composites					
Congressional Add: Texas Microfactory					
Congressional Add: Waves, Wind & Scavengers: Next Generation Renewable Energy Systems for Naval Applications					
Congressional Add: Computational Modeling and High Performance Computing in Advanced Material Processing, Synthesis and Design					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601153N: <i>Defense Research Sciences</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Biochemical Agent Detection</i>		0.798	0.000
Congressional Add: <i>Evaluating ELF Signals in Maritime Environments</i>		1.596	0.000
Congressional Add: <i>Navy Science and Technology Outreach (N-STAR) Maryland</i>		0.997	0.000
Congressional Add: <i>Center Quantum Studies</i>		1.197	0.000
Congressional Add: <i>Research Support for Nanoscale Research Facility</i>		2.792	0.000
Congressional Add Subtotals for Project: 9999		20.046	17.088
Congressional Add Totals for all Projects		20.046	17.088
<b><u>Change Summary Explanation</u></b>			
Technical: Not applicable.			
Schedule: Not applicable.			
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601153N: <i>Defense Research Sciences</i>				<b>PROJECT</b> 0000: <i>Defense Research Sciences</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Defense Research Sciences</i>	385.515	412.019	429.767	0.000	429.767	443.593	466.118	480.310	503.304	Continuing	Continuing

## A. Mission Description and Budget Item Justification

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S&T investment in basic research also includes the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend. There are currently four NNRs.

## B. Accomplishments/Planned Program (\$ in Millions)

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
AIR, GROUND AND SEA VEHICLES	51.020	52.347	56.511	0.000	56.511
Efforts include: Surface/subsurface reduced signatures; free-surface, subsurface, and propulsor hydrodynamics; hull life assurance; advanced ship concepts; distributed intelligence for automated survivability; advanced electrical power systems; air vehicles; air platforms propulsion and power;					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
air platforms survivability and signature control; special aviation projects; Unmanned Air Vehicle/ Unmanned Combat Air Vehicle (UAV/UCAV); environmental quality; logistics; and power generation, energy conversion, and storage.  FY 2009 Accomplishments: Air Vehicles - Continued investigations into controlled initiation and recovery from aggressive non-linear aero-maneuvers conducted by unmanned air vehicles. - Continued university research in rotorcraft technology areas such as tilt rotor aeromechanics, rotor flow field/ship air wake coupling during shipboard operations, flight simulation of advanced ducted fan air vehicles, active rotor control for enhanced ship board operations, autonomous rotorcraft operations in shipboard environment, and innovative rotor design concepts for naval applications. - Continued research in computational simulation of rotorcraft operations in shipboard environment. - Continued investigation of advanced structural concepts providing a high degree of crew protection during crashes.  Ship Concepts and Hydrodynamics - Continued modeling and optimization techniques for Naval design of multi-hulls, optimal functional arrangements for both ship and submarine design, and optimization for semi-displacement craft. - Continued implementation of nationwide program to increase interest in naval engineering education. - Continued further examination of computational mechanics to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control. - Continued propeller tip vortex cavitation and sheet-to-cloud cavitation. - Continued computational and experimental investigation into complex three-dimensional flow separation problems. - Continued modeling and understanding of full-scale circulation control bow planes design.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed measurement and modeling of small wave effects on wave breaking and bubble generation.</li><li>- Completed the Research Tools Development Consortia Program.</li><li>- Initiated validation of Unsteady Reynolds Averaged Navier Stokes (URANS) prediction on maneuvering effects on ship motion in waves.</li><li>- Initiated modeling of hydroacoustics of advanced materials propulsor.</li><li>- Initiated program to investigate renewable energy technologies for navy applications.</li><li>- Initiated computational and experimental investigations of wakes in stratified fluids.</li><li>- Initiated Large Eddy Simulation (LES) modeling of crashback of underwater vehicle with propulsor.</li></ul> <p>Ship Signatures, Structures, and Materials</p> <ul style="list-style-type: none"><li>- Continued the structural performance of hybrid ship hulls and hybrid joints subject to sea loads and weapons effects for application to high speed, low signature vessels.</li><li>- Continued modeling of alternating current sources and propagation.</li><li>- Continued Particle Image Velocimetry (PIV)/Laser Doppler Velocimetry (LDV) studies of multiphase bubble flows and interaction with elastic plates in a small quiet water tunnel.</li><li>- Continued LDV of scaling effects studies of unsteady elastic duct and propulsor interaction in a wind tunnel.</li><li>- Continued effort on much higher strain rate loading and constitutive behavior of Explosion Resistant Coating (ERC) for strain rates appropriate to ballistic events.</li><li>- Continued work on cohesive elements for dynamic fracture under combined mode for application to failure in joints in ship structures under blast loading.</li><li>- Continued work on hybrid ship (no-magnetic stainless steel/composite) hull concepts.</li><li>- Continued further examination of computational mechanics in order to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis, and error control.</li><li>- Continued concept for photonic band gap waveguide.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued methods to model the mechanisms of interaction between an elastic duct wall and fluid-flow in a duct with a propeller.</li><li>- Continued development of advanced multispectral InfraRed (IR) materials.</li><li>- Continued development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.</li><li>- Continued development of mmWave material characterization system.</li><li>- Continued efforts in alternative hull for fast ships and hybrid ship hull structures.</li><li>- Continued efforts in understanding of explosion resistant coating under extreme loads and its interaction with other armor and structural materials.</li><li>- Continued investigation into methods to control airborne noise transmission using active control.</li><li>- Continued development of metamaterial concepts for radio frequency (RF) signature control and photonic and acoustic applications.</li><li>- Continued experimental facility for sea-slamming loads in fast ships, and considering hydro-elasticity and structural details in composites panels and scale effects. Measurements are used developing new theoretical models.</li><li>- Initiated study of droplet &amp; volume scattering phenomena.</li><li>- Initiated the development of predictive models for infrared emission and reflection from breaking waves.</li><li>- Initiated development of computational electromagnetic tools for electromagnetic materials design &amp; optimization.</li><li>- Initiated development of a methodology for highly reliable composite to metallic joints.</li><li>- Initiated fundamental efforts in multi-scale, time-varying, hull structural reliability models and processes for structural performance analysis.</li><li>- Initiated basic research challenge on elastomeric polymer by design to protect the warfighter against traumatic brain injury by diverting the blast induced shock waves from the head.</li></ul>						
Ship and Air Platform Machinery and Systems <ul style="list-style-type: none"><li>- Continued efforts to understand and control the generation and propagation of far-field jet noise.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of Pulsed Detonation Engine (PDE) Technology.</li><li>- Continued development and understanding of control capabilities and distributed intelligence strategies for shipboard systems.</li><li>- Continued propulsion system cost-reduction efforts through reduction of vibration, noise and thermal fluctuation at the source by controlling combustion.</li><li>- Continued passive and active high speed noise control.</li><li>- Continued studies of alternate propulsion systems for PDE and generated prediction models.</li><li>- Continued investigation of thermal management approaches for cooling high power electronic devices.</li><li>- Continued research on non-vapor compression based refrigeration cycles.</li><li>- Initiated studies of advanced air-breathing propulsion concepts.</li><li>- Initiated study of advanced materials for Pulsed Detonation Engine (PDE) applications.</li><li>- Initiated efforts to expand the model based reasoning control algorithm approach to multiple heterogeneous systems.</li><li>- Initiated studies of complexity in heterogeneous distributed control systems.</li><li>- Initiated efforts to investigate a market based control approach to distributed control.</li><li>- Initiated efforts to perform physics based modeling of fluid actuation systems.</li></ul> <p>Power Generation, Energy Conversion and Storage</p> <ul style="list-style-type: none"><li>- Continued evaluation of stability and control of electrical power systems.</li><li>- Continued analyzing synchronization of 19 diode lasers to produce intense beams.</li><li>- Continued efforts in nanostructures, novel electrolytes, and electrode materials to enable new 3D power source architectures and to improve capacity of rechargeable lithium and lithium-ion batteries.</li><li>- Continued exploration and development of materials for high energy density passive power electronics (Capacitors).</li><li>- Continued expanding the fundamental understanding of direct electrochemical oxidation and the use of logistic fuels in solid oxide fuel cells.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete development of photonic crystal waveguide and radiating systems.</li><li>- Initiate the development and understanding of elastomeric polymers for multi functionality in protection systems/armor and structural acoustics with superior properties against environmental effects and extreme temperature.</li></ul> <p>Ship and Air Platform Machinery and Systems</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p>Power Generation, Energy Conversion and Storage</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li></ul> <p>FY 2011 Base Plans:</p> <p>Air Vehicles</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul> <p>Science of Autonomy</p> <p>This new sub-activity has been added beginning in FY 2011 to identify on-going efforts that were not previously mentioned specifically.</p> <ul style="list-style-type: none"><li>- Continue multi-disciplinary research in the science of autonomy including multi-vehicle collaboration, intelligence, and human interaction.</li><li>- Continue research in scalable and robust distributed collaboration among autonomous systems.</li><li>- Continue research in human/unmanned system collaboration.</li><li>- Continue research in autonomous perception and intelligent decision-making.</li><li>- Continue research in intelligent architectures for autonomous systems.</li></ul> <p>Ship Concepts and Hydrodynamics</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div>- Initiate computational prediction and validation of damaged ship maneuvering.</div> <div>Ship Signatures, Structures, and Materials</div> <div>- Continue all efforts of FY 2010, less those noted as completed above.</div> <div>- Complete development of advanced multispectral IR materials.</div> <div>- Complete development of mmWave material characterization system.</div> <div>- Complete validation of infrared ship signature models.</div> <div>- Initiate development of advanced electro magnetic energy absorbing composite materials.</div> <div>- Initiate and perform measurements of sea-slamming loads in fast ships at various sea states and speeds for composites panels on the experimental facility and develop/verify theoretical/computational models considering hydro elasticity and structural details and scale effects.</div> <div>Ship and Air Platform Machinery and Systems</div> <div>- Continue all efforts of FY 2010.</div> <div>Power Generation, Energy Conversion and Storage</div> <div>- Continue all efforts of FY 2010.</div>					
ATMOSPHERE AND SPACE SCIENCES	25.223	30.009	29.938	0.000	29.938
<div>Efforts include: Marine Meteorology and Prediction and Space Sciences. Beginning in FY 2009, this activity includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities. Accomplishments and plans described below are examples for each effort category.</div> <div>The increase in funding in FY 2010 and out reflects an increased emphasis in marine meteorology.</div> <div>FY 2009 Accomplishments: Marine Meteorology and Prediction</div>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued analysis of results from major field projects on air-sea interaction and transition improvements into applied research to improve the treatment of fluxes in coupled atmosphere-ocean prediction systems.</li><li>- Continued the development of next-generation ocean-atmosphere coupled models.</li><li>- Continued effort to investigate and better understand the bulk exchanges, aerosol-cloud interaction, and physical processes that take place at the atmospheric boundary layer interface.</li><li>- Continued theoretical and observational effort to improve understanding of the fundamental dynamics of mountain waves, including generation, propagation, nonlinear interaction, and wave breaking.</li><li>- Continued effort to gain a fundamental understanding of the flow-dependent limits of predictability by combining research in data assimilation and atmospheric instability.</li><li>- Continued investigation into the near-earth environmental effects on electromagnetic propagation.</li><li>- Continued investigation of sub-grid-scale processes that influence marine boundary layer turbulence, aerosol production and removal, and marine stratocumulus cloud and drizzle formation and dissipation with the goal of improving the predictability of these phenomena in high-resolution mesoscale prediction systems.</li><li>- Continued investigation of Western Pacific tropical cyclone dynamics in order to improve the predictability of storm genesis, structure and intensity changes, radii of maximum winds and effects on sea surface waves.</li><li>- Continued effort to assimilate WindSat wind vector, Ozone Mapping and Profiler Suite (OMPS) ozone profiles, and Global Positioning System (GPS) temperature and water vapor profile retrievals into NOGAPS (Navy Operational Prediction System).</li><li>- Continued effort to derive sea foam coverage from WindSat and to use this information in microphysical aerosol models to derive marine optical properties.</li><li>- Continued assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models.</li><li>- Continued development of new soil moisture retrieval algorithm that addresses the basic modeling issues pertinent to soil moisture retrieval using passive microwave data from the WindSat instrument.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued demonstration and validated a new data assimilation capability in NOGAPS ALPHA to generate the first global atmospheric analysis fields that extend from the ground to the edge of space.</li><li>- Initiated effort to derive and test advanced nonlinear atmospheric data assimilation algorithms using variational and ensemble techniques that are firmly based on modern inverse problem theory.</li><li>- Initiated effort to understand the fundamental physics and dynamics that control cloud and aerosol variability in the marine boundary layer.</li></ul> <p>Space Sciences</p> <ul style="list-style-type: none"><li>- Continued effort to exploit the polarimetric aspect of WindSat for non-ocean surface wind vector Meteorological and Oceanographic Command (METOC) retrievals. Effort this year focused on soil moisture and sea ice.</li><li>- Continued assessment of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.</li><li>- Continued program to develop advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.</li><li>- Continued monitoring of other-agency efforts for 'Naval Harvest' of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.</li><li>- Continued a focused program to develop a predictive, operational capability for the onset and evolution of equatorial spread-F that limits space-based communications and navigation capabilities.</li><li>- Continued a program to use large high frequency/very high frequency (HF/VHF) arrays to investigate fine scale ionospheric phenomena with associated improvements in ionospheric modeling and the performance of current and future DoD capabilities impacted by ionospheric disturbances.</li><li>- Continued program to extend magnetohydrodynamic models of solar activity, and related effects on the near-Earth space environment, toward an improved predictive capability on communication and navigation systems, and other related effects on DoD operations.</li><li>- Continued effort to develop better physical understanding of small-scale atmospheric wave dynamics in the middle and upper atmosphere.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued effort to develop understanding of how multi-scale interactions impact the predictability of tropical cyclones and their downstream effects.</li><li>- Continued effort to develop understanding to forecast the sun's changing extreme ultraviolet (EUV) radiation and the responses of the upper atmosphere and ionosphere one-to-ten days in advance.</li><li>- Continued effort to develop and validate numerical models of high-energy solar energetic particle (SEP) and solar gamma-ray (SGR) emissions.</li><li>- Continued effort to develop a quantitative standard model for solar flares that satisfies UV-X-ray observations; understand the origin, dynamics, and evolution of plasma in active region magnetic flux tubes.</li><li>- Completed the development of 3D magnetohydrodynamic code for simulations of solar filament eruptions leading to flare and coronal mass ejection (CME) activity.</li><li>- Initiated effort to develop the basis for an observational technique potentially enabling the first physics-based prediction of the severity of the largest energetic particle events generated by the Sun.</li><li>- Initiated investigation in the feasibility of using Thompson scattering to directly and globally image the near-Earth electron density distributions and their variations driven by the solar wind to enable space environment forecasting and comprehensive space domain awareness for the Navy and DoD.</li><li>- Initiated investigation of the driving mechanisms, mode characteristics, and impact on space plasmas of electromagnetic waves relevant to radiation belt remediation and auroral ionospheric space weather.</li><li>- Initiated research on advanced EUV/X-ray optics and associated spectral modeling and data analysis, to improve the precision of solar irradiance monitoring and enable accurate irradiance forecasts.</li></ul> <p>FY 2010 Plans:</p> <p>Marine Meteorology and Prediction</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>		R-1 ITEM NOMENCLATURE PE 0601153N: <i>Defense Research Sciences</i>		PROJECT 0000: <i>Defense Research Sciences</i>		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of Government, academic and industry researchers to accelerate the transition of new science and technology into fielded systems.  This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.  <i>FY 2009 Accomplishments:</i> <ul style="list-style-type: none"><li>- Continued effort in the area of Prediction to develop theoretical and technical approaches that permit prediction and analysis of IED emplacement as well as the assembly of IEDs. This included recognition of emplacement patterns, human activity recognition from video and other sensing systems, human intelligence and social network analysis of terrorist networks, modeling and simulation of the full spectrum of IED activities, analysis of communications, and knowledge management systems to combine diverse data sources.</li><li>- Continued effort in the area of Detection to develop concepts that would permit stand-off detection and localization of the explosive, the case materials, the environment in which the device is located, and other components of the IED.</li><li>- Continued effort in the area of Neutralization to develop scientific concepts that may be applied to remotely render an IED ineffective without necessarily having to detect or destroy it.</li><li>- Continued effort in the area of Destruction to develop scientific concepts that may be applied to quickly and remotely destroy IEDs without necessarily having to detect them.</li><li>- Continued effort in the area of Mitigation to develop scientific concepts that may be applied to protect people and/or equipment from the destructive effects of an IED that may be detonated.</li><li>- Continued computational fluid dynamics (CFD) CT-Analyst technology that provides a sensitive operational-quality capability to backtrack airborne detections of the chemical signatures and taggants of explosives instantly to their source.</li><li>- Continued reactive flow dynamics study of multiphase reactive flow modeling and simulation that can be applied to investigate mitigation strategies to counter the IED threat.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued investigation and development of nonlinear methods to more effectively describe and analyze hyperspectral and multi-sensor data to improve characterization using nonlinear (manifold) methods.</li><li>- Continued development of nonlinear methods to significantly improve the differentiation of targets from background scenes in multivariate data sets of hyperspectral imagery.</li><li>- Continued creation of new spectroscopy for sensitive characterization of semiconductor nanostructures, ultra-thin molecular films and chemical/biological threat materials and explosives.</li><li>- Continued development of high-power mid-Infrared (IR) lasers for IR countermeasures, explosives detection (ED), biological detection, remote chemical sensing, etc.</li><li>- Continued development of product that will provide the warfighter protection against blast pressure wave and complements efforts in ballistic/projectile protection and combat casualty care communities.</li><li>- Continued development of a new chemical explosive detection concept based on pump/probe ultrashort pulse lasers.</li><li>- Continued effort to develop a chemically strengthened visible infrared (Vis-IR) composite window made from Spinel ceramic and germanate glass.</li><li>- Continued research on characterizing background noise in urban and riverine environments in support of IED signature detection.</li><li>- Completed flame suppression mechanism investigation of additives to fine water mist to provide the scientific basis to guide search for suitable fine water mist based fire suppression strategies for DoD platforms, and to mitigate explosive blast effects.</li><li>- Completed the study of molecular motions &amp; physical properties under stress to develop better elastomers for applications of flexible materials: blast resistant coatings, sonar domes, appliques.</li><li>- Completed study of metal nanoparticles for insensitive munitions (IM) with high energy density and low sensitivity to hazardous conditions, operational environment and countermeasures.</li><li>- Completed development of rapid identification of biological aerosols, a novel method that allows specific biological aerosols to be identified within a background of others and that can fulfill the criteria of continuous sampling, real time performance, use of a small amount of consumables, and portability.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed a systems biology approach for the interrogation of marine microorganisms to describe and predict the functioning of an entire marine bacterial system in response to certain stimuli which will provide the ability to comprehensively model and manipulate microbiological systems for the development of next generation sensors for biological, chemical and explosive agent detection.</li><li>- Initiated a Counter-IED Grand Challenge effort to pursue innovative device neutralization modalities, augmented by device detection technologies.</li><li>- Initiated development of high performance polymer materials for armor applications.</li><li>- Initiated effort to directly observe lattice deformations in explosives under shock impact.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Initiate analytical study to detect an intruder in proximity to an underwater pipeline using structure-guided acoustic waves.</li><li>- Initiate increased emphasis on sociological and cultural aspects of defeating insurgent networks.</li><li>- Initiate increased emphasis on standoff wide area neutralization and pre-detonation of IEDs.</li><li>- Initiate increased emphasis on stronger lightweight armor including nanoparticle designs.</li><li>- Initiate increased emphasis on detection of physical and temporal device characteristics.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>						
HUMAN SYSTEMS  Efforts include: Human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; and pattern recognition.  The increase in funding in FY 2010 and out reflects an increased emphasis in immersive sciences for training, cognitive and neural sciences, research in learning and decision models and computational and algorithmic approaches to behavior of individuals, social groups and networks.		12.119	16.620	17.289	0.000	17.289

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued research of social networks for counterterrorism.</li><li>- Continued expansion of the cognitive architectural modeling capability to increase coverage, including spatial reasoning, multi-tasking, and impact of physiological and stress variables.</li><li>- Continued research of human cognition and performance to create more realistic simulations for training.</li><li>- Continued program to combine cognitive architectures with computational neuroscience to better predict human performance.</li><li>- Continued program on implantable electronics for performance enhancement.</li><li>- Continued research of hierarchical, cellular, and hybrid organization structures for command and control.</li><li>- Continued schema theory applications to multi-echelon command decision making.</li><li>- Continued investment in natural language interaction capability for artificially intelligent training systems.</li><li>- Continued research of neuro-control of high-lift bioinspired Unmanned Underwater Vehicles and active vision and cognitive navigation skills in mobile robots.</li><li>- Continued computational neuroscience for novel pattern recognition and sensory augmentation.</li><li>- Continued social-science based computational toolsets for terror network analysis at U.S. Pacific Command's Joint Intelligence Center and on the USS TARAWA (LHA-1) to support Expeditionary Strike Group One in Overseas Contingency Operations.</li><li>- Continued investigations to support new missions for Expeditionary Strike Groups in three areas: 1) analysis and diagnosis of Command and Control Organizational structures; 2) effects-based operations and development of reach-back capability for course of actions analysis; and 3) decision support systems for management of Battle Rhythm.</li><li>- Continued research of human-robot interaction to support team collaboration.</li><li>- Continued computational and agent-base modeling and experimentation to explore options for Effects-Based Operations.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued models of operational decision making for component commanders of an Expeditionary Strike Group with special emphasis on elaboration and planning knowledge.</li><li>- Continued research of integrated parallel optimization models of adaptive function and responsibility reallocation between commanders/staff and reconfiguration of the command, control, and communication organizational structures.</li><li>- Continued the output human performance usability models with actual human performance results obtained in usability testing on systems under development. These systems include future Naval Combat Systems and Homeland Security Operation Centers.</li><li>- Continued investigation of human sensory performance for optimizing video and audio human-electronic device interfaces.</li><li>- Initiated research to create new social modeling tools for understanding the responses of adversaries, determining the best practices for containing and deterring the adversary, and developing effective course of action in non-Western environments for humanitarian and civilian-military operations.</li><li>- Initiated research of advanced biometrics such as biodynamic signatures to support spirals 2 and 3 of the Navy Identity Dominance System - Maritime Domain.</li><li>- Initiated efforts to extend the representational capabilities of cognitive architectures to accommodate aspects of social cognition and teamwork.</li><li>- Initiated efforts to develop an empirical understanding and prediction of the behaviors of individuals and social groups and networks, computational approaches to social network theory and the co-evolution of adversarial tactics and strategies, algorithms for exploring scenarios that take into account socio-cultural factors; political and economic factors; local attitudes, values, and social structure.</li><li>- Initiated research focused towards cognitive and neural sciences, virtual/immersive environment simulators, and decision models for improved warfighter performance.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate research of human activity and intend recognition and dynamic biometrics for improved human system interfaces and force protection.</li><li>- Initiate research into probabilistic reasoning in computation cognitive architectures.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate research into computational social neuroscience to provide new models for manpower assignment and incentivization and new social models of cross-cultural interactions.</li></ul>						
INFORMATION SCIENCES  Efforts include: Mathematical foundation and computational theory and tools for design, communication, and control of intelligent autonomous systems; theory, algorithms and tools for decision support; decision theory, algorithms, and tools; heterogeneous information integration, management, and presentation; information assurance, secure and reliable information infrastructure for Command and Control; mathematical optimization for optimal resource allocation and usage; modeling and computation of complex physical phenomena; modeling and computation for electromagnetic and acoustic wave propagation and scattering; seamless, robust connectivity and networking; and expeditionary operations Command, Control, Communications, Computers Intelligence Surveillance and Reconnaissance (C4ISR).  The increase in funding from FY 2010 and out reflects an increased level of investment and effort for information technology for software systems.  <i>FY 2009 Accomplishments:</i> <ul style="list-style-type: none"><li>- Continued development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, resource allocation, and logistics.</li><li>- Continued development of improved tactical and battlespace decision aids.</li></ul>		29.472	33.896	34.572	0.000	34.572

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and multi-source signal data.</li><li>- Continued to investigate methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles.</li><li>- Continued efforts for enabling teams of autonomous systems to work together and work on representations for evolution of cooperative behaviors, including efforts in multi-modal interactions with autonomous systems.</li><li>- Continued developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems.</li><li>- Continued efforts on quantum computing and cryptography.</li><li>- Continued efforts on model checking and automated theorem prover technologies.</li><li>- Continued efforts on biometric technologies for authentication.</li><li>- Continued efforts in physics-based modeling of natural phenomena.</li><li>- Continued efforts in mathematical techniques for inverse problems, including reliable approximate solutions in 3 dimensions (3D); adequate representation of the physics of the media and the scatterer; and improved resolution of structural and material properties.</li><li>- Continued focused efforts in development of mathematical foundations for image understanding on a number of key challenges, such as multi-modal imagery representation and metrics, object recognition, scene analysis and understanding.</li><li>- Continued focused university efforts on statistical data analysis of non-traditional data types, such as text, open source, and streaming data in order to develop a computational statistics framework for integrating information of disparate sources.</li><li>- Continued a study of mathematical functional spaces to represent, compute, and analyze data of diverse and disparate nature in order to develop a robust computational theory for automated information integration of disparate sources of data.</li><li>- Continued development of mathematical, statistical, and computational framework leading to robust underlying approaches for automated information integration of disparate sources of data.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed efforts on communications and networks.</li><li>- Completed development of technology to re-engineer legacy code.</li><li>- Completed development of technology to improve analysis of distributed systems.</li><li>- Completed development of technology for analyzing functionality of executable software code.</li><li>- Completed development of technology for assessing effectiveness of automatic translation programs.</li><li>- Initiated research in cognitive radio and networking protocols.</li><li>- Initiated research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas.</li><li>- Initiated research in cross-layer wireless protocols for delay sensitive network traffic.</li><li>- Initiated multidisciplinary research efforts to focus on intelligent control systems, cooperative behavior modeling and response, UxV-human interactions and adaptive mission methodologies.</li><li>- Initiated development of an interaction model of how users characterize visual content and context to improve video surveillance.</li><li>- Initiated development of improved formal foundations, methods, and tools for compositional verification and construction of high assurance software systems.</li><li>- Initiated investigation of relational constructive induction, semi-supervised learning, and classifier ensembles to improve collective classification technology and operations based automated decision aids.</li><li>- Initiated research aiming to develop principled, trustworthy, yet practical and usable approaches to address the issue of software producibility and the development of complex software systems with ensured interoperability.</li><li>- Initiated research into anti-tamper and information assurance: research focused on protection techniques, architectures, algorithms, protocols that allow for security and cyber situational awareness.</li><li>- Initiated research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas.</li><li>- Initiated research to develop mathematical and computational tools for compressive sensing.</li><li>- Initiated the development of theory and algorithms for quantum communications.</li><li>- Initiated the effort to increase basic research into the extraction of information from large data sets.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as completed above. - Initiate basic research efforts addressing the representation, computation, and analysis of information from large diverse data sets. - Initiate research efforts to develop tools for proactive information assurance and cyber space security.						
FY 2011 Base Plans: - Continue all efforts of FY 2010. - Initiate research efforts addressing computational complexity arising from network-enabled computing, such as cyber security, information integration, and intelligent autonomy of networked, cooperative systems.						
MATERIALS/PROCESSES  Efforts include: Structural materials; functional materials; maintenance reduction; Environmental Sciences; and Manufacturing Science. Accomplishments and plans described below are examples for each effort category.  This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.  FY 2009 Accomplishments: Structural Materials - Continued development of first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels. - Continued development of models and simulations to understand and predict high deformation rate blast behavior for engineered topological structures.		56.750	61.485	64.021	0.000	64.021

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection.</li><li>- Continued quantification of the corrosion effects on fatigue to be incorporated into the Unified Damage Model and validate in a few environmental cases on P-3 aircraft real loads data.</li><li>- Continued developing carbon nanotubes growth and mechanical behavior in advanced composites for next generation ship and aircraft structures.</li><li>- Continued development of theoretical basis for composite materials behavior based on x-ray computed micro-tomography.</li><li>- Continued development of understanding and constitutive models of dynamic behavior of naval steels.</li><li>- Continued evaluating environmental effects on marine composites and sandwich structures.</li><li>- Continued exploration of composition, processing and microstructural evolution in titanium alloys for marine structures.</li><li>- Continued exploration of multienergy processes for zero maintenance coatings.</li><li>- Continued first lubrication-by-design experiments.</li><li>- Continued high temperature, low frictional sliding coefficient materials for elevated operating temperature gas turbine engine bearings.</li><li>- Continued investigation of a rapid annealing of surface layers and their effects.</li><li>- Continued multi-scale (atomic to microscopic) physics/chemistry-modeling of friction, wear, and lubrication for the rational design of high performance bearings, gears, seals, and lubricants.</li><li>- Continued the investigation of processing science (single crystals, coatings, thermal barrier coatings (TBC), heat treatment, etc) to materials performance for turbine engine components to develop relevant process protocols to optimize and control quality.</li><li>- Continued to advance the understanding of processing and deformation mechanisms in nanostructured ceramic composites and metal alloys to provide new high strength-high toughness materials for Naval platforms.</li><li>- Continued to develop the science of sliding contact and lubrication using physical and chemical first principles.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued to investigate the use of photorefractive crystals for the demodulation of a distributed fiber optic Bragg gratings structural health monitoring system.</li><li>- Continued research on new hybrid composites that integrate polymers, structural fibers, carbon nanotubes, ceramics and metals, with improved blast, ballistic, fire resistance and mechanical characteristics with special emphasis at the interfacial aspects of the new materials.</li><li>- Continued efforts to understand and predict salt chemistry effects on high temperature coatings and materials in naval gas turbine environments.</li><li>- Continued understanding for development of modeling tools for enhancing dynamic response and projectile resistance for sandwich structures.</li><li>- Completed development of physics-based models of thermal and materials flow during friction stir welding of steels, including the development of residual stresses that will lead to distortion.</li><li>- Completed research tools design efforts in dynamic three dimensional control of structures.</li><li>- Completed research tools design efforts in chemical dynamics.</li><li>- Completed development of progressive damage models for blast effects on composite marine structures.</li><li>- Initiated the fatigue life prediction model analysis on high temperature engine materials.</li><li>- Initiated development of new methods for room temperature curing and processing of polymer composites with high temperature thermoxidative stability and fire resistance.</li><li>- Initiated assessment of the blast resistance of cellular structures as functions of soil characteristics.</li><li>- Initiated development of seamless ceramic joining technology for the fabrication of large, complex shape conventional ceramic windows for IR, radar and visible light shipboard systems from small, inexpensive components using electrophoretic deposition of ceramic nanoparticles.</li><li>- Initiated development of understanding and constitutive models of competing and complementary microstructural factors influencing both dynamic behavior and weldability of high strength steels and naval titanium alloys.</li><li>- Initiated materials and fabrication science for fugitive phase processes for engineered topological structures for vehicle blast and fragmentation protection.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Functional Materials - Continued research tools design efforts in electromagnetic and acoustic bandgap materials. - Continued study of new transduction mechanisms. - Continued development of the science and technology base for a highly efficient and stable flexible organic solar cell. - Continued examination of the effects of acoustic perturbations and interactions in reacting flows and determine how they can be used. - Continued exploration and prediction of new sonar materials based on first principle methods. - Continued extension of first principle calculations of sonar materials tensor piezoelectric and dielectric properties to complex solid solutions to provide the basic understanding and predictive capability for ultra high strain materials. - Continued first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate. - Continued investigation into the properties and fabrication of novel ceramics which have potential to combine hardness, strength, and high transmission in the long wave infrared (LWIR) spectral region. - Continued exploration of innovative technologies such as capacitive micro-machined acoustic transducers for naval sonar systems. - Continued study of standoff detection of explosive materials and devices. - Continued development of methods for the intentional, controlled, impurity doping of semiconductor nanocrystal wires. - Continued effort to synthesize beta-SiC power suitable for subsequent densification into transparent beta-SiC ceramic. - Continued meta-materials effort to develop negative index materials with dynamic frequency response. - Continued synthesis and property measurement of new sonar materials predicted by first principle methods. - Initiated expansion of first-principles methods devised to calculate piezoelectric properties of materials for sonar transducers to calculate additional materials properties for other applications.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated design, processing, and measurements to fashion the new generation of high-strain, high coupling piezoelectric single crystals into high-performance acoustic transducers for naval sonar systems.</li><li>- Initiated basic research into material technology associated with the development of active and conventional armor.</li><li>- Initiated effort to characterize regenerative bacterial nanowires.</li><li>- Initiated effort to synthesize cyclic peptide ring modules and polymerize them into peptide nanotube polymers.</li><li>- Initiated efforts to utilize chemically modified virus proteins as a scaffold to assemble nanostructured metamaterials with unique optical properties including negative index of refraction.</li><li>- Initiated effort to develop surface electrons on diamond.</li></ul> <p>Maintenance Reduction</p> <ul style="list-style-type: none"><li>- Continued development of corrosion models.</li><li>- Continued mechanistic studies of materials deterioration under chemical environment for ship materials and their interfaces.</li><li>- Continued mechanism-based modeling of H-assisted cracking in ultra high strength steels.</li><li>- Continued stainless steel carburization study to enhance corrosion performance.</li><li>- Continued studies on understanding and modeling sea water corrosion effects of thermal cycling of AA 5XXX series.</li><li>- Continued the concept study of multiscale corrosion modeling on naval ship materials.</li><li>- Continued fundamental theoretical and experimental studies on nanoscale corrosion of metals and alloys.</li><li>- Continued corrosion prediction using an integrated deterministic-based model.</li><li>- Continued grain boundary engineering to improve corrosion resistance of marine grade aluminum alloys.</li><li>- Continued modeling and simulation of corrosion phenomena.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed identification of stress corrosion control methods for friction stir welded high-strength aluminum alloys using advanced thermal treatments, chemical modifications, and surface mechanical processes to tailor compressive stresses.</li><li>- Initiated studies of surface microstructure optimization to enhance corrosion properties of navy marine alloys</li><li>- Initiated sensor development for monitoring microstructural changes on alloys under thermal and mechanical stresses.</li><li>- Initiated research focused on modeling and simulation for platform and system affordability, lifetime materials, shipboard wireless capability, automation to reduce manning.</li></ul> <p>Environmental Science</p> <ul style="list-style-type: none"><li>- Continued examination of scientific methods for pollution prevention, waste reduction, and hazardous material reduction for Naval Operations.</li><li>- Continued broad based program in anti-fouling and fouling release coatings including investigation of effect of new polymers, materials, processes, and novel testing methodologies for coating efficacy.</li><li>- Continued effort to determine most promising foul-release approaches based on silicones to meet Navy durability requirements.</li><li>- Continued effort to develop Reverse Osmosis (RO) pre-treatment strategies to allow water recycling on ships.</li><li>- Continued efforts on treatment strategies of oily water containing synthetic lubricants.</li><li>- Completed assessment of the fate and effects of chemical and biological contaminants in marine/ estuarine environments.</li><li>- Completed research tools design efforts in Sampling and Analytical Methodologies.</li></ul> <p>Manufacturing Science</p> <ul style="list-style-type: none"><li>- Initiated a multidisciplinary research task into furthering the sciences associated with advances in manufacturing processes.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: Structural Materials - Continue all efforts of FY 2009, less those noted as completed above. - Initiate exploration of fundamental mechanisms and initiate development of physics-based models of electrophoretic deposition of ceramic nanoparticles and subsequent sintering. - Initiate physics based models for coupled phenomena in marine composite structures (thermo-mechanical loads, environmental effects, and fluid-structure interactions.) - Initiate research on innovative concepts for effective radiation barrier coatings and ultra-low thermal conductivity barrier coatings.  Functional Materials - Continue all efforts of FY 2009. - Complete first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate. - Initiate efforts to develop oxide materials for power management, sensors, and information storage/processing  Maintenance Reduction - Continue all efforts of FY 2009, less those noted as completed above. - Initiate development of ab initio models of corrosion reactions. - Initiate development of coatings capable of actively responding to environmental stresses. - Initiate study of coating failure mechanism on coating-substrate interface. - Initiate research on innovative concepts for effective radiation barrier coatings and ultra-low thermal conductivity barrier coatings.  Environmental Science - Continue all efforts of FY 2009, less those noted as completed above.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>Manufacturing Science</p> <p>- Continue all efforts of FY 2009.</p> <p><i>FY 2011 Base Plans:</i></p> <p>Structural Materials</p> <p>- Continue all efforts of FY 2010.</p> <p>- Complete multi-energy processing approaches for the room temperature cure of polymeric materials with high temperature thermoxidative stability and fire resistance.</p> <p>Functional Materials</p> <p>- Continue all efforts of FY 2010, less those noted as completed above.</p> <p>- Initiate efforts to synthesize and characterize new materials with enhanced properties predicted by first principles methods.</p> <p>Maintenance Reduction</p> <p>- Continue all efforts of FY 2010.</p> <p>- Complete studies on mechanism based modeling of hydrogen assisted cracking in high strength alloys for marine applications.</p> <p>- Complete studies on understanding and modeling sea water corrosion effects of thermal cycling of AA 5XXX series.</p> <p>- Initiate development of environmental corrosivity modeling.</p> <p>- Initiate development of nanoscale modeling of corrosion kinetics.</p> <p>- Initiate development of surface tolerant coatings.</p> <p>Environmental Science</p> <p>- Continue all efforts of FY 2010.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Manufacturing Science - Continue all efforts of FY 2010.						
MEDICAL/BIOLOGY  Efforts include: Biosensors, bioprocesses, and bio-inspired systems; casualty care and management; casualty prevention; undersea medicine/hyperbaric physiology; biorobotics; expeditionary operations training; and chemical-biological defense. These efforts are coordinated with the Army and Air Force through joint program reviews and are complementary, not duplicative.  This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.  The funding increase in FY 2010 and out reflects increased investment in bio-inspired sciences.  FY 2009 Accomplishments: Medical Sciences - Continued research to understand individual variability in stress response. - Continued non-lethal weapons bioeffects research. - Continued work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures (e.g. directed energy). - Continued work in understanding the mechanisms of decompression illness and hyperbaric oxygen toxicity. - Continued work on genomics/genetics of infectious organisms of military relevance and signal of transduction. - Continued research in casualty care and management and casualty prevention, including investigations of mechanisms of hemorrhagic shock, blast injury, tissue repair, and the biomedical effects of military operational exposures such as directed energy, hazardous chemicals, and sound.		14.877	17.405	19.345	0.000	19.345

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued research in Genetic Polymorphisms, the stress response and their interaction with the immune system.</li><li>- Continued research to explore systematic relationships between cognitive and physiological responses to laboratory tasks under operational conditions.</li><li>- Continued research in the mechanism/effects of underwater thermal stress.</li><li>- Continued research in understanding skull bones injury and healing dynamics.</li><li>- Continued research to discriminate fatigue and stress performance effects.</li><li>- Initiated research in genetic basis of psychological stress.</li></ul> <p>Biological Sciences</p> <ul style="list-style-type: none"><li>- Continued research on biofouling with emphasis on barnacle adhesion studies using molecular biology tools.</li><li>- Continued work on microbial synthesis of energetic materials.</li><li>- Continued efforts focused on microbe-materials interfacial interactions to detect materials defects/failures.</li><li>- Continued research on invertebrate larval settlement in response to biofilms.</li><li>- Continued research to understand physiological effects of sound exposure on marine mammals from Navy sound sources other than sonar.</li><li>- Continued efforts in "smart cell engineering" to design microbes that can sense and destroy other microbes through antibiotic production, or can "sense" and qualify their surrounding environment and provide information back to the user.</li><li>- Continued combinatorial chemical screens for bacterial communication pathway inhibitors as potential antibiotics or fouling-control agents.</li><li>- Continued efforts to engineer plants to produce high value naval materials.</li><li>- Continued efforts utilizing metagenomic screens to identify novel bacterial activities related to nitration or synthesis of high-N heterocycles.</li><li>- Continued efforts to develop ultra-fast methodology for selecting DNA biosensor molecules.</li><li>- Continued research to generate label-free assays for biosensing at biointerfaces.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued research to identify inhibitors of lateral DNA transfer in bacteria.</li><li>- Continued work to identify plasma biomarkers of domoic acid toxicosis and leptospirosis in California sea lions, and develop a multiplexed assay to measure those plasma biomarkers.</li><li>- Completed research on biofouling microbial community succession.</li><li>- Completed efforts on biomimetic adhesives for underwater use.</li><li>- Completed biogeochemical research of Mississippi Sound sediments: Hurricane Katrina effects and recovery.</li></ul> <ul style="list-style-type: none"><li>- Completed research on toxicity and enzymatic pathways of biodegradation of Royal Demolition Explosive (RDX), High Melting Point Explosive (HMX) and Dinitrotoluene (DNT) in marine benthos.</li><li>- Initiated increased emphasis in efforts focused on microbe-materials interfacial interactions for detection of materials defects/failures, including corrosion, and for improved energy harvesting.</li><li>- Initiated increased emphasis in research on invertebrate larval settlement and metamorphosis in response to biofilms and various inhibitors of adhesion.</li><li>- Initiated efforts to identify molecular biomarkers for battlefield injuries, and high-fidelity biosensors for detection in vivo.</li><li>- Initiated research into biomolecular 'logic controllers' for in vivo biosensor and in vivo drug delivery systems.</li><li>- Initiated research on engineered cells for infection detection and treatment in wounds.</li><li>- Initiated research efforts focused on developing bio-inspired sensors, vehicles and systems for local ISR, WMD detection, personnel protection and affordability. Research elements include advances in microfabrication, biological materials, processing techniques, robustness and efficiency of systems.</li></ul> <i>FY 2010 Plans:</i> Medical Sciences <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Initiate research on long-term effects of exposure to submarine environments.</li><li>- Initiate research to explore mechanisms of "ultrasonic" hearing in divers.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate research to explore a novel opioid that will produce analgesia as effective as morphine, with minimal side effects.</p> <p>Biological Sciences</p> <p>- Continue all efforts of FY 2009, less those noted as completed above.</p> <p>- Initiate efforts to ascertain potential human health and environmental risks of novel nanomaterial-based ammunition primers.</p> <p>- Initiate research on stem cells in marine mammals and their potential clinical role.</p> <p>- Initiate development of a second set of molecular diagnostic tests for recently discovered viral pathogens of marine mammals.</p> <p>- Initiate research in elucidation of mechanisms of fish electric sense and near field low frequency acoustic perception.</p> <p>- Initiate research in mitigation of the effects of sleep deprivation.</p> <p>- Initiate research in stress effects on immune system.</p> <p>- Initiate research in cellular effects of high frequency EM fields.</p> <p><i>FY 2011 Base Plans:</i></p> <p>Medical Sciences</p> <p>- Continue all efforts of FY 2010.</p> <p>- Initiate interventions to mitigate underwater sound/blast effects.</p> <p>- Initiate research on improved trauma management in submarine special forces operators.</p> <p>- Initiate research on physiological and genetic effects of long-term diving.</p> <p>- Initiate research on heterotopic ossifications; injuries to bone material in soft tissue.</p> <p>Biological Sciences</p> <p>- Continue all efforts of FY 2010.</p> <p>- Initiate synthetic biology and microbiological bioenergy efforts.</p> <p>- Initiate research in self-assembly of proteins in water.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
OCEAN SCIENCES		80.265	80.904	81.941	0.000	81.941
<p>Efforts include: Littoral Geosciences and Optics; Marine Mammals and Biology; Physical Oceanography and Prediction; and Ocean Acoustics. Accomplishments and plans described below are examples for each effort category.</p> <p>This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>Littoral Geosciences and Optics</p> <ul style="list-style-type: none"><li>- Continued field programs to understand physical and biological processes responsible for the formation, maintenance, and breakdown of thin oceanographic layers which have a significant impact on undersea warfare sensors and weapons.</li><li>- Continued field, laboratory, and numerical studies of seafloor sand ripple genesis, evolution, and destruction and their effect on acoustical penetration of the sea floor.</li><li>- Continued efforts to investigate the effects of oceanic biota on the propagation and inversion of multi-frequency acoustical energy.</li><li>- Continued investigations of sources and properties of light scatter within the coastal ocean.</li><li>- Continued to investigate the physical processes that control re-suspension of bottom sediments and the resulting impact on optical and acoustical propagation.</li><li>- Continued investigations of oceanic processes within the surface boundary layer that control high-frequency variability in image propagation and distortion.</li><li>- Continued to investigate and characterize the impact of riverine sources of optically-important matter on underwater visibility, navigation, and surveillance.</li><li>- Continued field program to infer sea floor characteristics from observations of surface gravity waves.</li><li>- Continued effort to understand the extent and intensity of seafloor gas hydrate accumulations and coastal bio-optical response to air-ocean forcing.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued programs to estimate optical properties of coastal ocean water from above-surface sensing, using in-situ data for validation.</li><li>- Continued studies to predict tidal flat evolution in coastal/riverine/estuarine systems.</li><li>- Continued incorporation of improved understanding of tropospheric and stratospheric bulk exchanges, air-sea interface, boundary layer interface, coastal ocean dynamics, gas hydrate accumulation, and biological responses into atmospheric and ocean prediction models and tactical aids.</li><li>- Continued development of prediction models for distributaries deltaic coastal environments.</li><li>- Completed effort to improve accuracy of the "5-cm gravimetric geoid" and precise geodesy.</li><li>- Initiated studies of tidal flat evolution in wave dominated environments.</li></ul> <p>Marine Mammals and Biology</p> <ul style="list-style-type: none"><li>- Continued field trials of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.</li><li>- Continued new efforts on tracking of marine mammals using data fusion based on tags and remote sensing.</li></ul> <p>Physical Oceanography and Prediction</p> <ul style="list-style-type: none"><li>- Continued field studies/modeling to predict propagation and effect on acoustics of non-linear internal waves in the western Pacific.</li><li>- Continued development of a ship wave radar driven wave model to allow high resolution studies of near surface ocean processes and to support Sea Basing.</li><li>- Continued extensive internal wave field program off the New Jersey Shelf; field work coincided with and complemented the Shallow Water Acoustics Program.</li><li>- Continued an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.</li><li>- Continued design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued extensive 3-year field program on prediction of internal waves.</li><li>- Continued first field test of the Optimal Deployment DRI (ODDAS) in the South China Sea.</li><li>- Continued 5-year program on the analysis of coherent structures in rivers and estuaries in support of the prediction and characterization of denied areas.</li><li>- Continued a field and modeling program to predict mesoscale structures and rapidly-varying currents in the Philippine Archipelago using Synthetic Aperture Radar (SAR), Hyperspectral and other remote data together with new data assimilation methods.</li><li>- Continued field programs that demonstrate persistent monitoring and measurement of environmental structures using gliders.</li><li>- Continued workshops to define science needs for Sea Basing.</li><li>- Continued a Coupled Oceanographic-Acoustics modeling and field program to demonstrate the use of a fully coupled system in optimizing tactical reduction of uncertainty.</li><li>- Continued an integrated modeling and field experiment on determining custom self-learning wave databases and forecast systems/ship-movement and engineering systems for Sea Basing.</li><li>- Continued the pilot test of the novel data (synthetic aperture radar and Hyper-spectral) assimilation forecast system developed under Philippine experiment.</li><li>- Continued an Estuarine-Littoral Processes Interaction field study in muddy and tidal flat dominated regimes including a data assimilative prediction capability.</li><li>- Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography.</li><li>- Continued studies of internal waves and strait dynamics emphasizing field studies in the Celebes, Philippine, and Sulu Seas.</li><li>- Continued studies to understand how to sample ocean processes with gliders and other autonomous and remote sensing systems to support tactical oceanography.</li><li>- Continued the field experiment in Monterey Bay to examine the role of unresolved processes in model parameterizations.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued to develop state of the art numerical model assimilation and initialization techniques, improved physical parameterizations, air-sea interactions, and fidelity for atmospheric and ocean prediction systems.</li><li>- Continued development of expert system methods to characterize and predict Riverine/estuarine systems to support Naval Special Warfare, Marine Expeditionary Forces and new Riverine units.</li><li>- Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography.</li><li>- Completed studies of internal wave propagation in the South China Sea.</li><li>- Initiated studies of ocean and wave response to typhoons and monsoons in the Western Pacific.</li><li>- Initiated studies of how to predict the 'full battle space environmental cube' using networked sensors and multiply coupled ocean/wave/atmosphere/acoustic prediction systems to provide sea base and fleet force protection.</li></ul> <p>Ocean Acoustics</p> <ul style="list-style-type: none"><li>- Continued analysis of deep-water acoustic transmissions made in the North Pacific to understand the scattered sound field due to ocean volume variability and bathymetric features.</li><li>- Continued field experiments and modeling efforts to examine the performance of Acoustic Vector Sensors.</li><li>- Continued a field and modeling effort to simultaneously study shallow-water medium fluctuations and develop time-reversal communications using adaptive channel equalizers.</li><li>- Continued analysis and modeling to understand the physics of buried mine detection through broadband and synthetic aperture sonar.</li><li>- Continued shallow-water, shelf-break measurements and analysis to characterize the effects of the ocean water column and seabed variability on low- and mid-frequency acoustic propagation and scattering.</li><li>- Continued a field and modeling effort to establish the capabilities of underwater acoustic communications for FORCENet and persistent undersea surveillance.</li><li>- Continued the development and testing of geo-acoustic inversion and extrapolation methods.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued investigations into quantifying, predicting and exploiting uncertainty in acoustic prediction models.</li><li>- Continued to research effect of solitons and internal wave bores on acoustic propagation and buoyancy.</li><li>- Continued research to develop complex analytic equations that couple oceanographic modes, both horizontal and vertical, to their corresponding frequency-dependent acoustic modes to give direct acoustic prediction capability.</li><li>- Continued research to quantify uncertainty in acoustic field computations for multi-scale ocean environments using novel approaches involving Bayesian prediction and polynomial chaos expansions to embed environmental uncertainty into multi-scale ocean dynamics and acoustic propagation.</li><li>- Continued assessment of "time-reversal" propagation techniques for mitigation of environmental variability.</li><li>- Continued development of algorithms for accurate acoustic predictions in dispersive, turbulent, turbid water.</li><li>- Continued development of source waveform design for rough littoral seafloors.</li><li>- Continued effort to develop a methodology for expressing the semantics of physics-based environmental models to support automated computer applications.</li><li>- Continued effort to understand how mudflat sediments respond to dynamic processes.</li><li>- Continued effort to understand synoptic scale ocean variability in the strategic Turkish Straits System including water mass exchange between basins and vertical mixing.</li><li>- Continued field work on adaptive beam-forming using mobile, autonomous sensors.</li><li>- Continued research to enhance understanding of the vibrational response of elastic structures to flow-induced excitation while developing a first-principles model for the induced structural acoustic response and reradiated acoustic field.</li><li>- Completed investigation of acoustically induced magnetic fields using modern experimental equipment and numerical techniques.</li><li>- Initiated deep-water acoustic transmission measurements with emphasis on the Northern Philippine Sea.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund.						
FY 2010 Plans: Littoral Geosciences and Optics - Continue all efforts of FY 2009. - Complete field, laboratory, and numerical studies of seafloor sand ripple genesis, evolution, and destruction and their effect on acoustical penetration of the sea floor. - Initiate studies of dissipation of surface gravity waves by muddy seabed sediments.						
Marine Mammals and Biology - Continue all efforts of FY 2009. - Initiate new efforts to examine physiology of marine mammals in situ and to predict consequences of physiological and auditory stress to populations.						
Physical Oceanography and Prediction - Continue all efforts of FY 2009, less those noted as completed above.						
Ocean Acoustics - Continue all efforts of FY 2009. - Initiate data collection and analysis of deep water ambient noise with emphasis on the Philippine Sea.						
FY 2011 Base Plans: Littoral Geosciences and Optics - Continue all efforts of FY 2010, less those noted as completed above.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Marine Mammals and Biology - Continue all efforts of FY 2010.						
Physical Oceanography and Prediction - Continue all efforts of FY 2010. - Complete extensive internal wave field program off the New Jersey Shelf; field work will coincide with and complement the Shallow Water Acoustics program. - Complete an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models. - Complete a field and modeling program to predict mesoscale structures and rapidly-varying currents in the Philippine Archipelago using Synthetic Aperture Radar (SAR), hyper-spectral and other remote data together with new data assimilation methods. - Complete a coupled oceanographic acoustics modeling and field program to demonstrate the use of a fully coupled system in optimizing tactical reduction of uncertainty. - Complete a pilot test of the novel data (SAR and hyper-spectral) assimilation forecast system developed under Philippine experiment. - Complete extensive 3-year field program on prediction of internal waves, acoustics in internal wave fields, transmission loss, and dissipation in areas of internal wave breaking. - Complete first field test of the Optimal Deployment DRI (ODDAS) in the South China Sea. - Complete 5-year program on the analysis of coherent structures in rivers and estuaries in support of the prediction and characterization of denied areas. - Complete the field experiment in Monterey Bay to examine the role of unresolved processes in model parameterizations. - Initiate studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography. - Initiate the field and modeling experiments to determine the lateral dispersion and maxing parameterization needed to understand model turbulence and to model ocean circulation.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Ocean Acoustics - Continue all efforts of FY 2010. - Complete field experiments and modeling efforts to examine the performance of acoustic vector sensors. - Complete field work on adaptive beam-forming using mobile, autonomous sensors. - Complete research effect of solitons and internal wave bores on acoustic propagation and buoyancy. - Complete assessment of "time-reversal" propagation techniques for mitigation of environmental variability. - Complete field work on adaptive beam-forming using mobile, autonomous sensors. - Initiate reverberation and clutter modeling studies.						
SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH  Science and Engineering Education and Career Development activities include DON participation in science fairs, summer research interns/fellows at Navy laboratories, graduate fellowships for individuals expected to become members of the engineering faculty at Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs), and curricular enrichment programs. Outreach includes the encouragement, promotion, planning, coordination and administration of Naval Science and Technology.  The decrease in FY 2010 and out represents a decrease in availability of resources.  FY 2009 Accomplishments: - Continued awarding prizes at 400 regional high school science fairs and three national competitions. - Continued supporting high school summer interns at Navy laboratories. - Continued supporting undergraduate/graduate students as summer research interns at Navy laboratories. - Continued providing graduate fellowship support to HBCU engineering faculty candidates. - Continued funding Young Investigator research grants.		34.928	26.350	29.328	0.000	29.328

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued encouraging, promoting, planning, coordinating and administering naval Science and Technology programs.  FY 2010 Plans: - Continue all efforts of FY 2009.  FY 2011 Base Plans: - Continue all efforts of FY 2010.					
SENSORS, ELECTRONICS AND ELECTRONIC WARFARE (EW)  Efforts include: Sensing, diagnostics, and detectors; navigation and timekeeping; nano-electronics; wide band gap power devices; real-time targeting; Electro-Optical/Infra Red (EO/IR) electronics; EO/IR electronic warfare; EO/IR sensors for surface/aerospace surveillance; Radio Frequency (RF) sensors for surface/aerospace surveillance; solid state electronics; vacuum electronics; Integrated Topside Innovative Naval Prototype (ITS INP); and RF electronic warfare.  As directed by the Secretary of Defense, this activity reflects a increase in FY 2010 and out for Basic Research (6.1) to fund peer-reviewed research to develop innovative solutions and enhance the science and engineering base. The increase also includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities.  FY 2009 Accomplishments: - Continued monolithic integration of multifunctional materials to enable passive devices and sensors into wide bandgap semiconductor circuits. - Continued effort to increase power conversion efficiency in an organic plastic solar cell based on Carbon 60 and a transparent hole transporter, and a conducting polymer electrode with achievement of > 4%	44.114	51.844	53.604	0.000	53.604

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued investigation of physical basis for improved time and frequency standards using quantum-entangled ions and atoms.</li><li>- Continued investigation of ultra high speed logic and multiple-quantum-well devices with a goal of &gt;500 giga-hertz (GHz) samplers, in support of mixed signal circuits for receiver analog-to-digital converters (ADC's).</li><li>- Continued program to extend device performance and architectures to frequencies approaching tera hertz (THz).</li><li>- Continued program to incorporate Magnesium Diboride (MgB2) tunnel junctions into simple electronic logic structures.</li><li>- Continued study to determine if the coupling between spins in quantum dots mediated by the virtual excitons is sufficiently strong for use in solid state implementations for quantum information.</li><li>- Continued program on advanced epitaxial growth for novel Si-based detector applications.</li><li>- Continued development of a blind adaptive beamforming approach for the High Frequency (HF) radar case and compare with both the conventional and traditional approaches.</li><li>- Continued development of approaches for probability of detection for deterministic signals in stationary noise and quantify for non-stationary noise.</li><li>- Continued development of electromagnetic ultra-near-field holography.</li><li>- Continued development of sensitive miniature fluxgate magnetometers.</li><li>- Continued project to lower thermal gradients between active circuit elements and heat sinks.</li><li>- Continued projects to explore physical behavior of full arrays of nanoscale devices for logic, memory, and imaging.</li><li>- Continued research to develop electromagnetic ultra-near-field holography.</li><li>- Continued the growth of semiconductor quantum wires with controlled doping and heterostructure interfaces.</li><li>- Continued the initial study of the coherent control of wavefunctions in quantum dots.</li><li>- Continued the study of Reciprocal Quantum Logic (RQL) digital superconducting logic.</li><li>- Continued a program to apply innovative mass nanofabrication techniques to previously developed nanodevice arrays.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued a program on the control of deleterious defects in silicon carbide (SiC).</li><li>- Continued a program on the study of Quantum Dots and their application to coherent wavefunction control and quantum information.</li><li>- Continued a program on the tailoring of the optical, structural and electronic properties of semiconductor quantum wires.</li><li>- Continued a program to demonstrate non-volatile memory, based on spin-torque Magnetic Random Access Memory (MRAM), with switching speed &gt; 1 GHz and write currents small enough (&lt;1 mA) to be driven by superconducting Rapid Single Flux Quantum (RSFQ) logic.</li><li>- Continued a program to determine if the newly invented Reciprocal Flux Quantum Logic in fact delivers 2x higher speeds with 5x fewer Josephson junctions and power, while using the same underlying devices so that single chip hybrid circuits between it and the dominant RSFQ logic are feasible.</li><li>- Continued a program to investigate whether pattern dependent RF currents during plasma etching are responsible for observed variability in Josephson junction characteristics in complex circuits and, if so, define design rule changes to avoid the effects.</li><li>- Continued demonstrations of tunable analog filters made in a digital Nb device foundry.</li><li>- Continued development of techniques to observe directly the electrical properties of pair states in high temperature superconductors.</li><li>- Continued research of a novel extension of the Generalized Radon Transform to establish appropriate wavenumber representations for arbitrarily oriented wave guides, surfaces, and structures.</li><li>- Continued work on optical manipulation of ultra-cold atoms.</li><li>- Continued investigation of temporal-spatial noise shaping circuits and architectures for high power digital-to-analog conversion with objectives of doubling spectral bandwidth, reduction of element density (15%), and extension of multidimensional Nyquist limits to both linear and planar arrays.</li><li>- Continued the evaluation and assessment of hardware-compatible space-time algorithms for Digital Signal Processor (DSP) applications to Transmit/Receive (T/R) arrays.</li><li>- Continued research to improve mixed signal III-V device and circuit modeling with objectives of achieving a 30 dB dynamic range improvement for complex circuits containing over 100,000 devices.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed investigation of extension of interference model and adaptive structures to produce waveforms that are transparent to non-users.</li><li>- Completed non-cooperative target identification from multiple aspects.</li><li>- Completed development of a general mathematical framework for developing advanced infrared countermeasures and analyzing/optimizing their effectiveness.</li><li>- Completed the demonstration of single and two-qubit operations of spins in quantum dots.</li><li>- Completed the study of defects involved in limiting the minority carrier lifetime in SiC.</li><li>- Completed the study of the use of InAs, Ga2O3 quantum wires for optical, structural and electronic applications.</li><li>- Completed project to develop linear higher power microwave wide bandgap semiconductor bipolar transistors based on distributed polarization effect (graded composition) base growth and processing technology.</li><li>- Initiated project to explore graphene based nanoelectronic devices.</li><li>- Initiated program in chip-scale quantum architectures.</li><li>- Initiated project to reduce heat transfer through electrical leads in cryogenic packaging.</li><li>- Initiated project to explore development of devices, sigma delta and time encoder circuits for near THz switching with objectives of enabling analog and digital conversion at millimeter wave frequencies.</li><li>- Initiated high-sensitivity magnetometry using quantum logic.</li><li>- Initiated materials studies of low temperature regenerator (high thermal capacity) materials and/or controlled flow microstructures with the goal of improving energy efficiency of cryocoolers.</li><li>- Initiated research into fundamental concepts and mathematics for digital array architectures.</li><li>- Initiated research to apply carbon nano-tube technology to acoustic sensing.</li><li>- Initiated research to investigate two-dimensional electron gases in perovskite oxide heterostructures.</li><li>- Initiated project to investigate self-assembled one-dimensional GaN channels in AlGaN/GaN structures.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete research effort to investigate target and signal characteristics based on non-Archimedean geometry.</li><li>- Complete the study of RQL digital superconducting logic.</li><li>- Initiate research effort to determine the most appropriate tunnel barrier for MgB2 Josephson junctions.</li><li>- Initiate an effort to grow low defect density, high purity epitaxial 4H-SiC at high growth rates suitable for high power electronic device applications.</li><li>- Initiate design, construction, and testing of sonic crystals that can be tuned to have specific acoustic properties.</li><li>- Initiate effort to create a physics-based understanding of epitaxial oxides and insulators for use in applications for advanced electronics.</li><li>- Initiate investigation into stabilizing in-phase coherent state of coupled systems for coherent power generation.</li><li>- Initiate high output impedance solid state device technologies and materials.</li><li>- Initiate effort to fabricate functionalized micro-opto-mechanical systems for the measurement of micromechanical photothermal spectra of adsorbed chemical vapor analytes.</li><li>- Initiate research effort on chemical synthesis and bandgap tailoring in graphene nanoribbons.</li><li>- Initiate research on spin dynamics in Group IV semiconductors and related device concepts.</li><li>- Initiate research efforts on non-conventional nanofabrication that hold promise for sub-10nm resolution.</li><li>- Initiate studies of the physics origin of noise and behavioral fluctuations in superconducting circuits, especially analog to digital converters, and incorporate the understanding into computer aided circuit simulators.</li><li>- Initiate studies of the generation and recombination dynamics of non-equilibrium quasiparticles associated with digital switching events in superconducting logic.</li><li>- Initiate investigation of metamaterials with embedded active devices to better understand multidimensional signal processing from RF through THz frequencies.</li><li>- Initiate effort on nuclear optical frequency standard in thorium 229.</li></ul>						

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate studies of intraband transitions in wide bandgap quantum wells.</li><li>- Initiate studies of how to prevent flux trapping and diagnose its occurrence in complex superconducting circuits and to design real time expert measurement systems in general for testing of new designs defined in VHSIC (Very High Speed Integrated Circuits) Hardware Description Language (VHDL).</li><li>- Initiate studies of the use of non-linear optical (phonon-photon interactions) phenomena as a method of cooling to cryogenic temperatures.</li><li>- Initiate effort to investigate statistical representations of target and signal techniques.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Initiate high output impedance solid state amplifier technologies.</li><li>- Initiate program of ultraprecise gravitational measurements using atom interferometry.</li></ul>						
WEAPONS  Efforts include: Undersea Weaponry; Energetic Materials and Propulsion; Expeditionary Operations (communications, materials for forensic sensing, landmine detection, human sensory enhancements, lightweight power sources and information efficiency); Directed Energy; and Applied Electromagnetics.  This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.  The increase in FY 2010 and out is due to a larger investment in electromagnetics science.  <i>FY 2009 Accomplishments:</i> Undersea Weaponry		16.355	18.458	20.692	0.000	20.692

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued conducting basic research related to critical S&amp;T (including vehicle control, maneuverability, and stability) associated with the development of High-Speed Supercavitating Vehicles (HSSV).</li><li>- Continued expansion of the University Laboratory Initiative (ULI) Program to provide a further infusion of educated and career-minded scientists and engineers in support of the National Naval Responsibility (NNR) for Undersea Weapons Research.</li><li>- Continued computer code refinements and investigation of supercavitating vehicle dynamics and instability.</li><li>- Continued evaluation of viable synthesis methodologies and characterization of candidate explosive ingredients suitable for undersea weapons applications.</li><li>- Continued development of diagnostic capabilities to accurately determine aluminum combustion characteristics in oxidizing environments.</li><li>- Continued an Otto Fuel II characterization study for undersea weapons.</li><li>- Continued isolation and characterization of the tetranitroborate anion as a candidate ingredient suitable for undersea warheads applications.</li><li>- Continued studies of low probability of intercept sonar, metalized explosives, lattice deformation of crystalline explosives, high thermal conductivity nanocomposites for vehicle arrays, microplasma fuels reforming and biomimetric propulsion mechanisms for underwater vehicles exploiting flutter instability.</li><li>- Continued development of an acoustic propagation model for rapid and accurate calculations for undersea weaponry applications.</li><li>- Continued the novel signal processing approach for detection and classification of countermeasures.</li><li>- Continued development of concept for weaponized Unmanned Undersea Vehicles (UUVs) based on game-theoretic approach.</li><li>- Completed efforts in nonlinear control laws, gas ventilation, and vehicle stability associated with the development of HSSV.</li><li>- Completed hydroacoustics models and experiments to reduce the self noise on cavitator acoustic array.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 1: Basic Research		R-1 ITEM NOMENCLATURE PE 0601153N: Defense Research Sciences		PROJECT 0000: Defense Research Sciences		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed assessment of electro-optical technology focused on enhancing undersea warhead fuzing systems.</li><li>- Completed analysis of geological false targets for torpedo systems.</li><li>- Completed fuel cell concept development using hydrogen peroxide reformat as oxidant.</li><li>- Initiated validation of hydroacoustic models and test and evaluate acoustic array signal processing algorithms.</li><li>- Initiated study on propulsion and its interaction with supercavitating cavity, and control surfaces.</li><li>- Initiated acoustic concepts formulation and modeling for low-noise bio-inspired propulsion systems.</li><li>- Initiated concept development on inversion of swarm dynamics for underwater tactical applications.</li><li>- Initiated new coating concepts for corrosion and anti-fouling protection of UUVs.</li></ul> <p>Energetic Materials and Propulsion</p> <ul style="list-style-type: none"><li>- Continued development of a fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.</li><li>- Continued exploring the use of quantum mechanics and molecular dynamics to provide fundamental properties for energetic materials to predict initiation/detonation criteria for insensitive munitions applications.</li><li>- Continued investigation of JP-10 combustion-based Proton-Exchange-Membrane (PEM) fuel cells.</li><li>- Continued investigation of multi-tube multi-nozzle Pulse Detonation Engines (PDEs) and multi-tube common nozzle PDEs.</li><li>- Continued investigation of nanometallic-hydrocarbon hybrid catalytic combustion for increased energy release rates.</li><li>- Continued investigation of novel initiation techniques, optimize injection parameters, and demonstrate integrated single tube operation for PDEs.</li><li>- Continued Advanced Energetics research in reactive, explosive, and propulsive energetic materials, including high energy ingredient synthesis &amp; characterization, and fundamentals of initiation and decomposition mechanisms, to tailor energy release processes in order to achieve substantial performance gains and/or enhanced survivability in harsh environments.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.</li><li>- Continued to develop organometallic-based highly energetic ingredients.</li><li>- Continued efforts to explore alternative fuel concepts for Naval applications to include hydrogen, synthetic diesel, and biodiesel.</li><li>- Continued development of multi-parameter sensor for multi-phase combustion flows (UAV and underwater PDEs).</li><li>- Continued implementation of new &amp; nanostructured materials design concepts for direct energy conversion and waste energy conversion.</li><li>- Continued investigation of integrated pulse detonation engine-airframe for autonomous vehicles, and pulse detonation for passive weapons (noise, jamming).</li><li>- Continued studies to determine the best investment of technologies for Unmanned Undersea Vehicle (UUV) Guidance and Control (G&amp;C).</li><li>- Continued hydroacoustics models and experiments to reduce the self noise on cavitator acoustic array.</li><li>- Continued acoustic signal processing algorithms for HSSV guidance and control.</li><li>- Continued development of new concepts for underwater power generation.</li><li>- Continued development of non-lethal undersea warheads for Overseas Contingency Operations.</li><li>- Continued development of PDE for underwater applications.</li></ul> <p>Expeditionary Operations</p> <ul style="list-style-type: none"><li>- Continued investigation of catalysts that reduce the pre-processing requirements for using logistic fuels in solid oxide fuel cells.</li><li>- Continued research in quantum optics, nano-microscale self assembly and molecular recognition for active forensic sensing.</li></ul> <p>Directed Energy</p> <ul style="list-style-type: none"><li>- Continued research thrust in directed energy weapons.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued directed energy development in the areas of advanced optical components and coatings for high energy lasers, high power injector and photocathode development, beam control and tracking research, terahertz source development and applications, femtosecond laser application studies, and the modeling and simulation of high power laser operation.</p> <p>- Completed multi-disciplinary efforts to include coherent beamforming, beam correction, turbulence effects on propagation, materials for high energy systems and sources.</p> <p>- Initiated basic research into mechanisms and concepts supporting the defeat of and protection against speed of light weapons.</p> <p>Applied Electromagnetics:</p> <p>- Initiate program to conduct basic research and theoretical analysis in electromagnetic phenomena in the spectrum from microwaves to visible light. Areas of research will be in microwave directed energy, optical directed energy (lasers), terahertz sources, and related nanometer-scale electronics and sensors.</p> <p><i>FY 2010 Plans:</i></p> <p>Undersea Weaponry</p> <p>- Continue all efforts of FY 2009, less those noted as completed above.</p> <p>- Complete a proof of concept demonstration of a potential electro-optical technology enhancement capability for undersea warhead fuzing systems.</p> <p>- Complete isolation and characterization of the tetranitroborate anion as a candidate ingredient suitable for undersea warheads applications.</p> <p>- Complete development of an acoustic propagation model for rapid and accurate calculations for undersea weaponry applications.</p> <p>Energetic Materials and Propulsion</p> <p>- Continue all efforts of FY 2009.</p> <p>- Initiate new thrust on the design, synthesis and characterization of high energy dense oxidizers.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div><div>- Initiate structure property relationship studies on advanced propellant systems and high blast energetic compositions.</div><div>- Initiate synthesis and characterization of cluster complexes between reactive metals and energetic oxidizers and explosives.</div><div>Expeditionary Operations</div><div>- Continue all efforts of FY 2009.</div><div>Directed Energy:</div><div>- Continue all efforts of FY 2009, less those noted as completed above.</div><div>- Initiate research into advanced theoretical research and modeling of superconducting laser elements as used in advanced high energy accelerators.</div><div>Applied Electromagnetics:</div><div>- Continue all efforts of FY 2009.</div><div>FY 2011 Base Plans:</div><div>Undersea Weaponry</div><div>- Continue all efforts of FY 2010, less those noted as completed above.</div><div>- Complete the novel signal processing approach for detection and classification of countermeasures.</div><div>Energetic Materials and Propulsion</div><div>- Continue all efforts of FY 2010.</div><div>Expeditionary Operations</div><div>- Continue all efforts of FY 2010.</div><div>Directed Energy</div></div> <td></td> <td></td> <td></td> <td></td> <td></td>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy				<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601153N: <i>Defense Research Sciences</i>		<b>PROJECT</b> 0000: <i>Defense Research Sciences</i>				
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>								
				<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
- Continue all efforts of FY 2010.  Applied Electromagnetics - Continue all efforts of FY 2010.								
Accomplishments/Planned Programs Subtotals				385.515	412.019	429.767	0.000	429.767
<b>C. Other Program Funding Summary (\$ in Millions)</b>								
N/A								
<b>D. Acquisition Strategy</b>								
N/A								
<b>E. Performance Metrics</b>								
<p>Defense Basic Research seeks to improve the quality of defense research conducted predominantly through universities and government laboratories. It also supports the education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in an academic environment. Initial research focus is generally conducted in an unfettered environment because of the nature of basic research, but as more is learned and applications emerge, individual research projects take on a more applied focus. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. Example metrics include a biporous wick structure for thermal management of power electric modules capable of removing 900 watts per square centimeter which was recently developed by an academia/industry team. The National Research Council of the National Academies of Science and Engineering's congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.</p>								

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010															
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601153N: <i>Defense Research Sciences</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>															
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>												
9999: <i>Congressional Adds</i>	20.046	17.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	103.295												
<p><b><u>A. Mission Description and Budget Item Justification</u></b>  Congressional Interest Items not included in other Projects.</p> <p><b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b></p> <table border="1" style="width:100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 20%; text-align: center;">FY 2009</th> <th style="width: 20%; text-align: center;">FY 2010</th> </tr> </thead> <tbody> <tr> <td> Congressional Add: Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment   <i>FY 2010 Plans:</i>  This effort supports Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment research. </td> <td align="center">0.000</td> <td align="center">1.992</td> </tr> <tr> <td> Congressional Add: Energetics S&amp;T Workforce Development   <i>FY 2009 Accomplishments:</i>  This effort supported research focused on design, processing, and implementation of new energetic materials and energetic systems, both for performance and reduced sensitivity applications.   <i>FY 2010 Plans:</i>  This effort supports Energetics S&amp;T Workforce Development research. </td> <td align="center">4.488</td> <td align="center">3.485</td> </tr> <tr> <td> Congressional Add: Human Neural Cell-Based Biosensor </td> <td align="center">0.000</td> <td align="center">1.095</td> </tr> </tbody> </table>													FY 2009	FY 2010	Congressional Add: Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment  <i>FY 2010 Plans:</i> This effort supports Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment research.	0.000	1.992	Congressional Add: Energetics S&T Workforce Development  <i>FY 2009 Accomplishments:</i> This effort supported research focused on design, processing, and implementation of new energetic materials and energetic systems, both for performance and reduced sensitivity applications.  <i>FY 2010 Plans:</i> This effort supports Energetics S&T Workforce Development research.	4.488	3.485	Congressional Add: Human Neural Cell-Based Biosensor	0.000	1.095
	FY 2009	FY 2010																					
Congressional Add: Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment  <i>FY 2010 Plans:</i> This effort supports Characterization and Exploitation of Magnetic and Electric Fields in the Coastal Ocean Environment research.	0.000	1.992																					
Congressional Add: Energetics S&T Workforce Development  <i>FY 2009 Accomplishments:</i> This effort supported research focused on design, processing, and implementation of new energetic materials and energetic systems, both for performance and reduced sensitivity applications.  <i>FY 2010 Plans:</i> This effort supports Energetics S&T Workforce Development research.	4.488	3.485																					
Congressional Add: Human Neural Cell-Based Biosensor	0.000	1.095																					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Human Neural Cell-Based Biosensor research.		
Congressional Add: Next Generation; Manufacturing Processes and Systems <i>FY 2010 Plans:</i> This effort supports Next Generation; Manufacturing Processes and Systems research.	0.000	1.195
Congressional Add: ONAMI Nanoelctronics, Nanometrology and Nanobiotechnology Initiative <i>FY 2009 Accomplishments:</i> This effort explored novel measurement techniques to characterize nanostructures and devices, new nanometrology tools to image and measure the structure and composition of nanoscale objects and interfaces, and techniques for evaluation of nanoscale devices for logic and biosensing. <i>FY 2010 Plans:</i> This effort supports Onami Nanoelectronics, Nanometrology and Nanobiotechnology Initiative research.	3.989	3.824
Congressional Add: Shock and Vibration Modeling of Marine Composites <i>FY 2010 Plans:</i> This effort supports Shock and Vibration Modeling of Marine Composites research.	0.000	1.912
Congressional Add: Texas Microfactory	2.992	1.593

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development of a cost effective automated assembly and packaging system for microsystems in small lots by augmenting current equipment to include laser, electrical discharge machining and mechanical micromachining tools and top down nanomanufacturing tools. Demonstrated manufacturability techniques for steerable projectiles using 2D actuator arrays and microrobotic swarms to enhance the situational awareness of the warfighter.		
<i>FY 2010 Plans:</i> This effort supports Texas Microfactory research.		
Congressional Add: Waves, Wind & Scavengers: Next Generation Renewable Energy Systems for Naval Applications  <i>FY 2010 Plans:</i> This effort supports Waves, Wind & Scavengers: Next Generation Renewable Energy Systems for Naval Applications research.	0.000	1.992
Congressional Add: Computational Modeling and High Performance Computing in Advanced Material Processing, Synthesis and Design  <i>FY 2009 Accomplishments:</i> This effort supported computational modeling and high performance computing focused on material design, synthesis and processing. The interface energies between aluminum nanoparticles and hybrid composites consisting of epoxy resin and glass fabric were computed with an emphasis on understanding how distribution, concentration and orientation of the dispersed nanoparticles influence flow stresses during manufacture	1.197	0.000
Congressional Add: Biochemical Agent Detection	0.798	0.000

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the refinement of Quantum coherence techniques using femtosecond adaptive spectroscopic techniques with coherent anti-Stokes Raman spectroscopy refinement to allow the rapid (order of one second) detection of bacterial spores associated with anthrax. The technique selects a unique excitation pathway and avoids other responses by quantum destructive interference.		
Congressional Add: Evaluating ELF Signals in Maritime Environments  <i>FY 2009 Accomplishments:</i> This effort supported research performed to understand, model and measure Extremely Low Frequency (ELF) signals in water. The effort included full-scale deployment of test apparatus, performance of extensive ELF studies in the maritime environment, comparison of data sets from models and experiments, and improvement of codes and experimentation methods.	1.596	0.000
Congressional Add: Navy Science and Technology Outreach (N-STAR) Maryland  <i>FY 2009 Accomplishments:</i> The Naval Science and Technology for America's Readiness (N-STAR) effort included the development of an outreach activity at Navy R&D Centers collaborating with universities, community colleges, high schools, and middle schools to create a pipeline of students who are interested in pursuing careers in the science and engineering fields.	0.997	0.000
Congressional Add: Center Quantum Studies  <i>FY 2009 Accomplishments:</i> This effort supported the performance of theoretical studies of iron pnictides, superconductors, and nonabelian gauge potentials for ultracold atoms.	1.197	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601153N: <i>Defense Research Sciences</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Research Support for Nanoscale Research Facility  <i>FY 2009 Accomplishments:</i> This effort researched the development of new materials, techniques, and approaches for the fabrication of nanoelectronic devices and sensors to develop a fundamental understanding of nanoscale materials and phenomena.	2.792	0.000
<b>Congressional Adds Subtotals</b>	<b>20.046</b>	<b>17.088</b>
<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>		
N/A		
<b><u>D. Acquisition Strategy</u></b>		
N/A		
<b><u>E. Performance Metrics</u></b>		
Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	101.584	77.210	98.150	0.000	98.150	138.620	157.519	162.118	169.815	Continuing	Continuing
0000: Power Proj Applied Research	82.436	59.524	98.150	0.000	98.150	138.620	157.519	162.118	169.815	Continuing	Continuing
9999: Congressional Adds	19.148	17.686	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	138.986
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This PE supports both advanced technology research and near to mid-term transition opportunities. The advanced research focus is primarily on High Energy Lasers (HEL), Electromagnetic railgun development, high speed weapon propulsion, electro-optic/infrared (EO/IR) sensor technologies. The mid-term effort is focused on developing and demonstrating technologies supporting the Future Naval Capability (FNC) Program Enabling Capabilities (ECs) for Marine and Unmanned Vehicle Tactical Intelligence, Surveillance and Reconnaissance (ISR), Advanced Naval Fires Technology, Hostile Fire Detection and Response, Maritime Weapons of Mass Destruction Detection (MWMD-D), and Dynamic Target Engagement &amp; Enhanced Sensor Capabilities. Within the Naval Transformation Roadmap, this investment will achieve two of four key transformational capabilities required by Sea Strike as well as technically enable the Littoral Sea Control key transformational capability within Sea Shield.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		PE 0602114N: Power Proj Applied Research			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	98.651	59.787	0.000	0.000	0.000
Current President's Budget	101.584	77.210	98.150	0.000	98.150
Total Adjustments	2.933	17.423	98.150	0.000	98.150
• Congressional General Reductions		-0.322			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.015			
• Congressional Adds		17.760			
• Congressional Directed Transfers		0.000			
• Reprogrammings	4.039	0.000			
• SBIR/STTR Transfer	-1.106	0.000			
• Program Adjustments	0.000	0.000	98.150	0.000	98.150
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Advanced Helicopter Landing Aid				0.000	0.797
Congressional Add: Combustion Light Gas Gun Projectile				3.988	3.983
Congressional Add: Electronic Motion Actuation Systems				0.798	0.797
Congressional Add: Enhanced EO/IR Sensors				0.000	2.390
Congressional Add: Millimeter Wave Imaging				1.596	1.354
Congressional Add: Multifunctional Materials, Devices, And Applications				0.000	1.593
Congressional Add: Naval Advanced Electric Launcher System				0.000	1.992
Congressional Add: Strike Weapon Propulsion				0.000	3.187
Congressional Add: Aging Military Aircraft Fleet Support				1.596	1.593
Congressional Add: High Energy Conventional Energetics (Phase II)				3.190	0.000
Congressional Add: High Power Free Electron Laser Development for Naval Applications				2.394	0.000

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Marine Mammal Hearing and Echolocation Research</i>		1.596	0.000
Congressional Add: <i>Strike Weapon Propulsion (SWEAP)</i>		2.394	0.000
Congressional Add: <i>Unmanned Aerial Vehicle Fuel Cell Power Source with Hybrid Reforming</i>		1.596	0.000
Congressional Add Subtotals for Project: 9999		19.148	17.686
Congressional Add Totals for all Projects		19.148	17.686
<b><u>Change Summary Explanation</u></b>			
Technical: Not applicable.			
Schedule: Not applicable.			
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification: PB 2011 Navy</b>								<b>DATE: February 2010</b>			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>				<b>PROJECT</b> 0000: <i>Power Proj Applied Research</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Power Proj Applied Research</i>	82.436	59.524	98.150	0.000	98.150	138.620	157.519	162.118	169.815	Continuing	Continuing
<b><u>A. Mission Description and Budget Item Justification</u></b> This project addresses the technology issues involving the Navy's capability to project naval power on the broad seas and in the littoral regions.											
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<b>DIRECTED ENERGY AND EM GUNS (FORMERLY ELECTRIC WEAPONS)</b>						48.245	36.895	55.992	0.000	55.992	
<p>The goal of this activity is to develop Directed Energy (DE) and Electric Propulsion power weapons for Navy applications. The Directed Energy portion of this activity consists of two elements. The first element involves applied research and development of technologies supporting advanced accelerators with applications to directed energy weapons. The second portion of activity is the Free Electron Laser (FEL) Innovative Naval Prototype (INP) which if successful could be utilized for shipboard applications as a defensive weapon against advanced cruise missiles and asymmetric threats. The other major component in this activity is the Electro Magnetic (EM) railgun program that is focused on developing the technology to launch a long range projectile from Navy ships. This activity also includes NRL investment/performance in these research areas.</p> <p>Decrease from FY 2009 to FY 2010 is due to the reduction of 6.2 investment in the EM railgun and Direct Energy. The amount of the decrease was partially offset by the increase of the Free Electron Laser (FEL) investment in preparation for the FEL demonstration program.</p> <p>The increase in funding from FY10 to FY11 is primarily due to the start of the second contractual phase of the FEL INP program. As a result of the Phase 1A competition, a single contractor was awarded the contract in late FY10 and in FY11 begins the critical design, development and installation portion</p>											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of the FEL INP 100kW test and demonstration program. In addition long lead item procurement for the 100 kW FEL will begin in FY11. These long lead items require approximately 15 to 18 months for manufacturing and delivery to the test facility. The other element influencing the funding increase is the additional S&T investment required to develop compact, high performance FEL components such as the high power injector (super conducting and normal conducting Radio Frequency), the mirror/optical components and oscillator system, and the high power amplifiers. Additional development of these components is extremely critical for operation at required INP power levels and also to minimize the footprint FEL in anticipation of eventual ship integration.						
FY 2009 Accomplishments: Directed Energy and Accelerator Research: <ul style="list-style-type: none"><li>- Continued cryomodule and FEL component development at the FEL testing and integration facility.</li><li>- Continued investigation into the application of FEL technology to other areas including advanced materials, optics, bioscience, medical, manufacturing, weaponization, and solid state physics.</li><li>- Continued 1 micron filamentation, halo limitation, and short Rayleigh range studies.</li><li>- Continued testing of Radio Frequency (RF) gun High Voltage Power Supply (HVPS) components which are required for the 100 kW high current injector.</li><li>- Continued applied directed energy and accelerator research in: Compton radiation scattering, multiple dielectric thin film coatings, bunch characteristics of electron beam emittance, high grade electromagnetic field generators, electron beam lattice configuration, novel electron beam generation, novel high flux subatomic particle emission, high gain photonic amplification, fundamental power efficiency conversion. In addition continue the development of physics based models for: characterization of subatomic particle interaction and propagation and modeling for validation of photon control structures.</li><li>- Initiated Innovative Naval Prototype (INP) program for FEL.</li></ul> EM Gun: <ul style="list-style-type: none"><li>- Continued material, physics and thermal property research for both launchers and projectiles.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued launcher and projectile development.</li><li>- Continued preliminary design and lethality studies of projectile, design of next generation pulse power systems, IPT and Bore Life Consortium collaborations.</li><li>- Initiated development of modeling and simulation capability to support bore life development and testing.</li></ul> <p>Acquisition Workforce Fund:</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p><i>FY 2010 Plans:</i></p> <p>Directed Energy and Accelerator Research:</p> <ul style="list-style-type: none"><li>- Continue applied DE and accelerator research efforts of FY09.</li><li>- Continue Innovative Prototype (INP) program for the FEL. Hold Preliminary Design Review (PDR) for both contractors who were selected to participate in Phase 1A of the FEL INP program. Review proposals from the Phase 1A contractors. Downselect and award a contract to a single contractor to proceed forward in Phase 1B and the Critical Design Review (CDR) to be held in FY11.</li></ul> <p>EM Gun:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p>Applied Electromagnetics for High Power Weapons:</p> <ul style="list-style-type: none"><li>- Initiate a program to conduct applied research into applied electromagnetics as it applies to lasers, high power microwaves, and advanced sensors, including Modeling and Simulation tools for Directed Energy Weapons.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <p>Directed Energy and Accelerator Research:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continue detailed design efforts required for presentation at the CDR for Phase 1B of the FEL program. Detailed Design efforts include: preparation of design drawings (assembly, control, installation, schematics etc), material and parts listings (long lead item, parts, provisioning lists etc), analyses and reports (e.g. trade off study reports supporting design decisions, modeling &amp; simulation, safety and supportability reports, installation and assembly procedures, testing and maintainability analyses etc.), initial orders for long lead item components (eg cryomodules and RF system components). In addition some preliminary preparations will begin at the test facility selected for installation of the 100 kW FEL system.</p> <p>- Continue S&amp;T on critical FEL components that will be integrated into the final 100 kW demonstration. Further S&amp;T development of these components is required for the successful testing of the 100 kW FEL, to support the scale up of the 100 kW FEL into a megawatt class weapon, and to reduce the overall footprint of the system to support the eventual ship integration of the FEL. Additional S&amp;T investment and development will include the following components: the normal conducting and super conducting RF electron beam injectors, advanced high power cathode technologies, high power compact amplifiers, and advanced mirrors, coatings and optical components capable of handling the significantly higher energies that are present in a 100 kW level FEL.</p> <p>EM Gun:</p> <p>- Complete material, physics and thermal property research for single shot launchers, pulsed power and projectiles for 32MJ muzzle energy launch.</p> <p>- Complete lethality studies of projectile, design of next generation pulse power systems, IPT and Bore Life Consortium collaborations for 32 MJ launchers.</p> <p>- Complete development of modeling and simulation capability to support bore life development and testing.</p> <p>- Complete analysis to verify the models and simulations correlate to results achieved in testing for launchers, pulsed power and projectiles at 32MJ launch.</p> <p>Applied Electromagnetics for High Power Weapons:</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continue all efforts of FY 2010.						
HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES  The high speed weapons work in this activity is focused on demonstrating propulsion and vehicle technologies for Mach3+ to Mach8 capable weapons. The solid rocket motor Integrated High Performance Rocket Propulsion Technology (IHPRPT) technology development activities will provide improved rocket based weapon performance. The rocket technologies apply to both air dominance and strike weapons and will provide both improved range and speed.  Advanced propulsion for Unmanned Combat Air Systems will demonstrate key technologies such as integrated engine core, distortion tolerant fan and power generation essential for long-duration ISR (Intelligence, Surveillance and Reconnaissance)/Strike missions. These integrated technologies are necessary because conventional propulsion systems cannot achieve the desired performance characteristics needed for the highly embedded propulsion systems.  This work includes technologies associated with high acceleration capable projectile structures, high temperature and high strength materials to enable projectiles to survive high speed launch environment, improved thermal prediction methodologies and test techniques, wide dynamic pressure adaptable projectile controls and non-explosively launched lethal mechanisms. The high speed projectile technologies are intended to support long range Naval Fire Support weapons.  The decrease from FY 2009 to FY 2010 is due to reduction and development funding of the IHPRPT program with final testing to be done in FY 2010.  FY 2009 Accomplishments: Integrated High Performance Rocket Propulsion Technology (IHPRPT): - Continued development of surface launch component technologies.		7.900	1.557	1.755	0.000	1.755

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued program through demonstration of Solid Rocket Motor Phase III goals at the subsystem level.</p> <p>Asymmetric Threat &amp; Laser Control Technologies:</p> <p>- Continued development of propulsion and high temperature materials technologies to enable high speed weapons.</p> <p>- Continued demonstrating dual mode warhead effectiveness in both above and below water detonations.</p> <p>- Completed High Power Microwave (HPM) technology development.</p> <p>- Initiated high speed projectile technology development.</p> <p><i>FY 2010 Plans:</i></p> <p>High Speed Projectile &amp; Advanced Weapon Technologies (Formerly Asymmetric Threat &amp; Laser Control Technologies):</p> <p>- Continue high speed projectile technology development.</p> <p>- Complete IHPRPT program with final testing.</p> <p>Advanced Propulsion Technologies for Unmanned Combat Air System (UCAS):</p> <p>- Initiate development of technologies for a highly survivable embedded propulsion and power system which requires good thrust specific fuel consumption for missions requiring long range and endurance.</p> <p><i>FY 2011 Base Plans:</i></p> <p>High Speed Projectile &amp; Advanced Weapon Technologies (Formerly Asymmetric Threat &amp; Laser Control Technologies):</p> <p>- Continue all efforts for FY 2010 less those noted as complete above.</p> <p>- Initiate effort to develop advanced guidance and control technologies for high speed weapons.</p> <p>Advanced Propulsion Technologies for Unmanned Combat Air System (UCAS):</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continue all efforts for FY 2010.					
NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES  This activity describes Navy Science and Technology (S&T) investments in the areas of EO/IR devices and advanced sensors and includes NRL investment/performance in the technology areas of Electronics, Electronic Warfare, and Communications.  Decrease from FY 2009 to FY 2010 is due to a reduction in NRL related EO/IR/Sensor development activities.  FY 2009 Accomplishments: Electro Optic/Infrared: - Continued development of ultra low noise uncooled nanotechnology infrared sensors. - Continued development nanoatomic sensor nonvolatile memories. - Continued development of electronic field of view and zoom imagers. - Continued the development of an active optics system that can survey a wide area and instantly, non-mechanically zoom-in on an area of interest for target tracking/identification. - Continued development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats. - Continued development of high power fiber lasers in mid-IR (2-5 micro-m) based upon highly nonlinear IR transmitting chalcogenide photonic crystal fibers. - Completed THz Imaging project through transition to 6.3 developments. - Initiated effort to develop ultra-high-sensitivity detectors suitable for use in focal plane arrays (FPAs) for the short-wave infrared (SWIR) spectral band. - Initiated effort to develop mid & long wave IR focal plane arrays using graded-bandgap W-type-II superlattices w/much higher detectivity than that of state-of-the-art HgCdTe (MCT). - Initiated development of tunable narrowband infrared absorption technology.	7.597	3.842	3.437	0.000	3.437

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Communications: - Completed covert high bandwidth communications effort. - Completed development of free space laser communications systems with the development of a hybrid infrared system with dramatically lower power requirements at the sensor/transmitter. - Completed development of Micro Air Vehicle (MAV). - Completed small hyperspectral sensor development.  Autonomous Systems: - Continued the development of a novel beam steering method in phased array radar using optical fiber based slow light techniques. - Continued the development of machine-vision algorithms and guidance strategies to enable the precision autonomous recovery of small sensor platforms on moving naval vessels. - Continued the development of an autonomous soaring capability and intelligent path planning for extracting energy from the environment thereby conserving onboard fuel stores of autonomous air vehicles. - Completed design and development of a disposable MAV which will enable the airborne delivery and precision placement of miniature EW sensors and payloads. - Completed the design of an advanced auto gyrator that combines a swashplateless rotor system and active stability augmentation for autonomous systems.  Electronic Warfare: - Initiated development of an ultra-lean combustor for recuperated gas turbines.  FY 2010 Plans: Electro Optic/Infrared: - Continue development of tunable narrowband infrared absorption technology.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research	PROJECT 0000: Power Proj Applied Research			
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Complete development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats.</p> <p>Autonomous Systems:</p> <p>- Complete the development of a novel beam steering method in phased array radar using optical fiber based slow light techniques.</p> <p>- Complete the development of machine-vision algorithms and guidance strategies to enable the precision autonomous recovery of small sensor platforms on moving naval vessels.</p> <p>- Complete the development of an autonomous soaring capability and intelligent path planning for extracting energy from the environment thereby conserving onboard fuel stores of autonomous air vehicles.</p> <p>Electronic Warfare:</p> <p>- Continue all efforts of FY 2009.</p> <p><i>FY 2011 Base Plans:</i></p> <p>Electro Optic/Infrared:</p> <p>- Complete development of tunable narrowband infrared absorption technology.</p> <p>Electronic Warfare:</p> <p>- Complete development of an ultra-lean combustor for recuperated gas turbines.</p>					
STRIKE AND LITTORAL COMBAT TECHNOLOGIES	10.941	7.331	12.013	0.000	12.013
The focus of this activity is on those technologies that will support Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Decrease from FY 2009 and FY 2010 is due to delay in start of Selectable Ouput Weapons and Multi-Target Laser Designator.						
Increase from FY 2010 to FY 2011 is due to the initiation of Strike Accelerator Program and FNC new starts.						
FY 2009 Accomplishments: Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: - Continued development of Weapons Data Link terminal toward weapon scalability and modularity.  Dynamic Target Engagement: - Continued development of remote sensor fusion hardware for ground sensors, an ultra endurance UAV, and a GMTI sensor for use on UAVs. - Completed development of Decision Support System for dynamic target engagement.  Increased Capability Against Moving and Stationary Targets: - Continued DASH Program component design for the DASH multi-sensor weapon seeker and begin the mmW sensor fabrication and testing. - Continued of the Multi-Mode Sensor/Seeker (MMSS) project.  Enhanced Weapons Technologies: - Continued development of passive interferometric imaging system to detect millimeter wave RF anomalies within the background environment by using exotic signal processing techniques. - Continued the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. Transferred to 0602271N						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Complete development of passive interferometric imaging system to detect millimeter wave RF anomalies within the background environment by using exotic signal processing techniques.</p> <p><i>FY 2011 Base Plans:</i> Increased Capability Against Moving and Stationary Targets: - Initiate Strike Accelerator program. This effort will provide an advanced airborne capability to accurately identify targets using Advanced Target Recognition (ATR). These capabilities utilizing the F/A-18 E/F, AESA (Active Electronically Scanned Array) Radar and ATFLIR (Advanced Targeting Forward Looking Infrared) sensors will enable Strike Aircraft to quickly ID and Target maritime threats.</p> <p>Enhanced Weapon Technologies: - Continue all efforts of FY 2010, less those noted as completed above. - Initiate development and apply emerging technologies that support delivery of Technology Oversight Group approved FNC enabling capabilities structured to close operational capability gaps in power projection.</p>					
WMD DETECTION	7.753	9.899	24.953	0.000	24.953
<p>The Chief of Naval Operations (CNO) in the Navy Strategic Plan (NSP) has directed that the Navy be able to combat Weapons of Mass Destruction (WMD) at sea and Maritime domain. This activity addresses the development of key technologies for standoff detection of WMD's and component nuclear materials on ships at sea. The program will develop and demonstrate technology for actively detecting fissile material and other weapons of mass destruction.</p> <p>FY 2010 and FY 2011 increases represent the ramping up of the program as continuing technological efforts evolve. The testing of the equipment in realistic maritime environments significantly increases the cost of testing. The Maritime WMD Detection program in FY11 is moving from limited scale laboratory and field experimentation, into more complex, large scale demonstrations of Special Nuclear Material detection technologies. These tests must be conducted in a representative "Navy unique"</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
maritime environment which include both over water and under-water applications, and which require the expansion of required safety, simulation and validation of passive and active detection testing techniques. Additionally, the elimination of previously available neutron detection materials has forced an urgent technology development investment in alternatives to current helium based sensors to support the warfighter."						
FY 2009 Accomplishments: - Continued using particle beam (neutrons, gamma rays, muons, and others) to perform standoff detection of fissile material. - Continued investigations into the use of Free Electron Laser (FEL) accelerator technologies for the detection of WMD's and nuclear components & materials. Conducted experiments to determine the ability of the FEL to perform remote detection of nuclear material on surfaces, and chemical biological agents in aerosol clouds. - Continued development of hand-held and portable radiation detector technology to support maritime interdiction operations. - Continued modeling and simulation efforts to determine the ability to use neutron activation analysis to locate smuggled nuclear weapons and material through underwater detection. - Initiated planning for a maritime demonstration of standoff detection of fissile materials. This effort will involve formation of a team comprised of DoD, interagency, and international partners to support the demonstration.						
FY 2010 Plans: Weapons Mass Destruction Detection: - Continue all efforts of FY 2009.						
FY 2011 Base Plans: Weapons Mass Destruction Detection: - Continue all efforts of FY 2010.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research		PROJECT 0000: Power Proj Applied Research	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete investigations of hand held and portable detector technology for maritime interdiction, transition to demonstrations of available technologies in prototypes and other suitable formats.</li><li>- Complete standoff detection of fissile materials with a demonstration in a maritime environment from a suitable Naval vessel or surrogate. Demonstration will involve a team from DoD, DoE, interagency, academia partners to support the full demonstration.</li><li>- Initiate the technical development and testing of solid state high energy neutron detector without Helium 3.</li><li>- Initiate the development of technologies for remote real time imaging of suspected WMD in a maritime environment for both Passive Detection and Active Interrogation, including laboratory and field testing.</li><li>- Initiate a laboratory demonstration of short range active interrogation for WMD detection.</li><li>- Initiate the development of technology for and conduct "at sea" testing of underwater radiological WMD Detection from unmanned underwater vehicles (UUVs).</li><li>- Initiate the development and laboratory testing of a compact Nuetron Generator without need for cryogenic cooling.</li><li>- Acquire WMD Special Nuclear Material (SNM) simulator from DoE and conduct high fidelity field testing.</li><li>- Initiate the development of technology for and conduct radiological WMD Detection from Naval aviation platforms.</li><li>- Examine system human dose limits and health effects of various Remote Stand Off Detection techniques.</li></ul>					
Accomplishments/Planned Programs Subtotals	82.436	59.524	98.150	0.000	98.150

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602114N: Power Proj Applied Research				PROJECT 0000: Power Proj Applied Research			
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0603114N: POWER PROJECTION ADVANCED TECHNOLOGY	23.240	10.759	15.228	0.000	15.228	20.172	19.299	15.568	7.555	0.000	111.821
• 0602131M: MARINE CORPS LANDING FORCE TECHNOLOGY	0.000	0.119	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.119
D. Acquisition Strategy N/A											
E. Performance Metrics											
<p>This PE develops early components technologies that if successful can be integrated into weapon systems that meet warfighter requirements. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments). The metrics used to evaluate 6.2 programs are necessarily less precise than those used in 6.3 programs.</p> <p>The metrics for this PE can be divided into two categories: technological and organizational/functional. Technological metrics address the success of the work performed. The primary technological metrics used in this PE involve laboratory experiments/tests demonstrating proof of the concept for the technology. This demonstration is frequently a hand-assembled functioning breadboard of the concept. The organizational/functional metrics applied to this PE include: transition of the technology to advanced development in a 6.3 PE and applicability of the technology to documented warfighter problems or requirements. Successful implementation of these categories would result in the application of a pass/fail metric and further evaluation for possible transition to a 6.3 development/demonstration program.</p>											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	19.148	17.686	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	138.986
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Advanced Helicopter Landing Aid							0.000	0.797			
<i>FY 2010 Plans:</i> This effort supports Advanced Helicopter Landing Aid research.											
Congressional Add: Combustion Light Gas Gun Projectile							3.988	3.983			
<i>FY 2009 Accomplishments:</i> This effort supported the resolution of weaponization, system, and safety issues associated with combustion light gas gun technology and initiated development of guided projectiles for high acceleration, high velocity launch.											
<i>FY 2010 Plans:</i> Continue this effort to support combustion light gas gun projectile research.											
Congressional Add: Electronic Motion Actuation Systems							0.798	0.797			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the identification and development of solutions for the scientific and technological challenges inherent to the development of ship board prototype electric linear and rotary actuators.  <i>FY 2010 Plans:</i> Continue this effort to support Electronic Motion Actuation Systems research.		
Congressional Add: Enhanced EO/IR Sensors  <i>FY 2010 Plans:</i> This effort supports Enhanced EO/IR Sensors research.	0.000	2.390
Congressional Add: Millimeter Wave Imaging  <i>FY 2009 Accomplishments:</i> This effort supported the development of advanced photonic detectors for passive millimeter wave imaging.  <i>FY 2010 Plans:</i> Continue this effort to support Millimeter Wave Imaging research.	1.596	1.354
Congressional Add: Multifunctional Materials, Devices, And Applications  <i>FY 2010 Plans:</i> This effort supports Multifunctional Materials, Devices, and Applications research.	0.000	1.593
Congressional Add: Naval Advanced Electric Launcher System	0.000	1.992

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Naval Advanced Electric Launcher System research.		
Congressional Add: Strike Weapon Propulsion <i>FY 2010 Plans:</i> This effort supports Strike Weapon Propulsion research.	0.000	3.187
Congressional Add: Aging Military Aircraft Fleet Support <i>FY 2009 Accomplishments:</i> This effort supported the investigation of the effects of aging on composite structures as well as composite/metallic hybrid structures and the assurance of the airworthiness of composite components. The results of this investigation provided insight into the aging aspects of other composite aircraft structures and influence the use of advanced materials on new aircraft being proposed for military service as well as maintenance of the existing fleet. <i>FY 2010 Plans:</i> Continue this effort to support Aging Military Aircraft Fleet Support research.	1.596	1.593
Congressional Add: High Energy Conventional Energetics (Phase II) <i>FY 2009 Accomplishments:</i> This effort supported the investigation of the technical areas of detonation physics, explosive molecule synthesis, energetics formulations, and small scale testing to accelerate the development of the novel technologies required to defeat or neutralize the chemical or biological agent and associated weapons and equipment with little or no collateral effect, and defeat hard and deeply buried C3I/WMD targets.	3.190	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
This project supported the urgent requirement of the US to counter new types of asymmetric threats such as weapons of mass destruction using chemical-biological weapons.		
Congressional Add: High Power Free Electron Laser Development for Naval Applications  <i>FY 2009 Accomplishments:</i> This effort supported research in the injection gun portion of the technology which will substantially reduce the risk and cost of acquisition for shipboard speed of light self-defense against cruise missiles. This project enabled research focused on Naval directed energy weapons in support of fielding shipboard directed energy and electric weapon systems to significantly improve gunfire support for forces ashore.	2.394	0.000
Congressional Add: Marine Mammal Hearing and Echolocation Research  <i>FY 2009 Accomplishments:</i> This effort supported research conducted by University of Hawaii to study the hearing of captive marine mammals held at Hawaii Institute of Marine Biology on Coconut Island as well as studies on animals held captive in other facilities.	1.596	0.000
Congressional Add: Strike Weapon Propulsion (SWEAP)  <i>FY 2009 Accomplishments:</i> This effort supported research into the advancement of carbon-carbon material and design simplification of a hypersonic long range cruise missile to reduce the fabrication costs of the engine components.	2.394	0.000
Congressional Add: Unmanned Aerial Vehicle Fuel Cell Power Source with Hybrid Reforming	1.596	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602114N: <i>Power Proj Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development of a high power, lightweight solid oxide fuel cell (SOFC) propulsion system for unmanned air vehicles (UAV) to increase the technology readiness level through systems improvements and testing.		
Congressional Adds Subtotals	19.148	17.686
<b>C. Other Program Funding Summary (\$ in Millions)</b>		
N/A		
<b>D. Acquisition Strategy</b>		
N/A		
<b>E. Performance Metrics</b>		
Congressional Add		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602123N: Force Protection Applied Res							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	186.628	146.045	107.448	0.000	107.448	111.156	111.669	114.490	122.526	Continuing	Continuing
0000: Force Protection Applied Res	131.478	90.978	107.448	0.000	107.448	111.156	111.669	114.490	122.526	Continuing	Continuing
9999: Congressional Adds	55.150	55.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	241.702
A. Mission Description and Budget Item Justification											
<p>The efforts described in this program element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p> <p>This PE addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability. This is accomplished by improvements in platform offensive performance, stealth, and self defense. This PE supports the Future Naval Capabilities (FNC) Program in the areas of Sea Shield, Sea Strike, Cross Pillar Enablers and Enterprise and Platform Enablers (EPE).</p> <p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0602123N: Force Protection Applied Res			
BA 2: Applied Research					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	186.750	91.400	0.000	0.000	0.000
Current President's Budget	186.628	146.045	107.448	0.000	107.448
Total Adjustments	-0.122	54.645	107.448	0.000	107.448
• Congressional General Reductions		-0.612			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.043			
• Congressional Adds		55.300			
• Congressional Directed Transfers		0.000			
• Reprogrammings	4.012	0.000			
• SBIR/STTR Transfer	-3.335	0.000			
• Program Adjustments	0.000	0.000	107.448	0.000	107.448
• Rate/Misc Adjustments	-0.001	0.000	0.000	0.000	0.000
• Congressional Recision Adjustments	0.002	0.000	0.000	0.000	0.000
• Congressional Add Adjustments	-0.800	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Advanced Battery System For Military Avionics Power Systems	0.000	1.593			
Congressional Add: Advanced Composite Manufacturing For Composite High-Speed Boat Design	0.000	1.593			
Congressional Add: Advanced Energetics Initiative	0.000	3.983			
Congressional Add: Carbon Composite Thin Films For Power Generation And Energy Storage	0.000	1.593			
Congressional Add: Center For Autonomous Solar Power-Supercapacitors For Integrated Power Storage	0.000	3.983			
Congressional Add: Energetic Nano-Materials Agent Defeat Initiative	0.000	1.593			
Congressional Add: Fuel Efficient, High Specific Power Free Piston Engine For Ussvs	0.000	1.593			
Congressional Add: Lithium Ion Storage Advancement For Aircraft Applications	0.000	1.992			
Congressional Add: Multi-Mission Unmanned Surface Vessel	0.000	1.992			

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602123N: <i>Force Protection Applied Res</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Non-Traditional Ballistic Fiber And Fabric Weaving Application For Force Protection</i>		0.000	1.992
Congressional Add: <i>Hybrid Power Systems</i>		0.000	1.992
Congressional Add: <i>Proton Exchange Membrane Fuel Cell For Underwater Vehicles</i>		0.000	1.593
Congressional Add: <i>Advanced Simulation Tools for Aircraft Structures Made of Composite Materials</i>		1.197	1.593
Congressional Add: <i>Alternative Energy Research</i>		19.945	18.423
Congressional Add: <i>Deputee-High Powered Microwave Non-Lethal Vehicle/Vessel Engine Disabling</i>		1.596	0.000
Congressional Add: <i>Harbor Shield-Homeland Defense Port Security Initiative</i>		3.490	1.593
Congressional Add: <i>High Speed ACRC &amp; Composites Sea Lion Craft Development</i>		1.995	0.000
Congressional Add: <i>High Power Density Propulsion and Power for USSVs</i>		1.596	0.000
Congressional Add: <i>High Strength Welded Structures</i>		0.798	0.000
Congressional Add: <i>Integration of Electro-Kinetic Weapons into Next Generation of Navy Ships</i>		4.487	3.983
Congressional Add: <i>Lithium Batteries</i>		1.596	0.000
Congressional Add: <i>Lithium-Ion Cell Development with Electro Nano Materials</i>		3.988	0.000
Congressional Add: <i>Lithium-Sulfur Chemistry Validation for Sonobuoy Application</i>		1.596	0.000
Congressional Add: <i>Magnetic Refrigeration Technology</i>		2.394	3.983
Congressional Add: <i>Mk V.1 MAKO for Improved Signature and Weight Performance</i>		1.995	0.000
Congressional Add: <i>Naval Special Warfare 11m RIB Replacement Craft Design</i>		0.798	0.000
Congressional Add: <i>PMRF Force Protection Lab</i>		1.995	0.000
Congressional Add: <i>Planar Solid Oxide Fuel Cell System Demonstration at UTC SimCenter</i>		3.490	0.000
Congressional Add: <i>Shipboard Production of Synthetic Aviation Fuel</i>		0.997	0.000
Congressional Add: <i>Standoff Explosive Detection System (SEDS)</i>		1.197	0.000
Congressional Add Subtotals for Project: 9999		55.150	55.067

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602123N: <i>Force Protection Applied Res</i>		
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add Totals for all Projects		55.150	55.067
<b><u>Change Summary Explanation</u></b> Technical: Not applicable.  Schedule: Not applicable.  FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602123N: <i>Force Protection Applied Res</i>				<b>PROJECT</b> 0000: <i>Force Protection Applied Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Force Protection Applied Res</i>	131.478	90.978	107.448	0.000	107.448	111.156	111.669	114.490	122.526	Continuing	Continuing

## **A. Mission Description and Budget Item Justification**

This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability by virtue of improvements in platform offensive performance, stealth, and self defense. This effort supports the FNC in the areas of Sea Shield, Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE).

This project reflects the alignment of Future Naval Capability (FNC) program investments for the following Enabling Capabilities (ECs): Fortified Position Security, Over-the-Horizon Missile Defense, Anti-Ship Missile Defense Technologies, Two-Torpedo Salvo Defense, Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats, Sea Based Missile Defense of Ships & Littoral Installations, Aircraft Integrated Self-Protection Suites, Advanced Threat Aircraft Countermeasures, Helicopter Low-Level Operation, Four Torpedo Salvo Defense, Shipboard Force Protection in Port and Restricted Waters - Detection and Classification, Underwater Total Ship Survivability, Compact Power Conversion Technologies, Affordable Submarine Propulsion and Control Actuation, and Advanced Electronic Sensor Systems for Missile Defense.

Decrease in FY10 is due to the completion of a Power and Energy initiative. Increase in FY 2011 is due to large scale demonstrations of the Large Vessel Stopper systems and emphasis in the Power and Energy arena.

## **B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>ADVANCED ENERGETICS</b>	4.196	2.116	2.120	0.000	2.120
Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602123N: Force Protection Applied Res		PROJECT 0000: Force Protection Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>safety, reliability, and affordability concerns. Goals include: advanced energetic materials for warheads, propellants, and reactive material based subsystems for both defensive and offensive applications. Efforts include: development of new fuels, oxidizers, explosive ingredients and formulations; and reliable simulation tools and diagnostics to develop and design superior-performance, and/or reduced-vulnerability systems tailored to specific warfighter missions.</p> <p>Decreased funding in FY 2010 is due to the conclusion and transition of Advanced Energetics efforts in the areas of enhanced performance formulations, insensitive explosives, detonation merging techniques, and reactive materials. Remaining funding will be used to complete transition efforts and to develop next generation concepts as described below.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued Advanced Energetics research in technology development for the next generation reactive material warhead concepts (formulations, material properties, target interaction, lethality models, and experiments) for highly reactive materials, high density reactive materials and novel reactive structural materials.</li><li>- Continued Advanced Energetics research in development and evaluation of advanced explosive/propellant/reactive ingredients and formulations for next generation higher performing systems.</li><li>- Continued Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads.</li><li>- Continued proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts.</li><li>- Continued Advanced Energetics research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads.</li><li>- Continued Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
effectively couple energy to target for air, surface, and underwater warhead application- Continued research in technology development for the next generation reactive material warhead concepts (formulations, material properties, and energy release experiments) for highly reactive materials, high density reactive materials and novel reactive structural materials. Transition application specific target interaction, lethality modeling and ordnance specific experiments and demonstrations to Electro-magnetic Rail Gun, PE 0603114N. - Continued development of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target. Limit efforts to analytical and laboratory scale proof of concept experimental efforts. - Continued development and evaluation of energetic ingredients and formulations for next generation higher performance applications. Conclude scale-up development and testing. Transition to Integrated High Payoff Rocket Propellant Program, PE 0602114N. - Completed proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. Transition to Future Naval Capabilities Program. - Completed development of and transition directed hydro-reactive material warhead concepts to Undersea Warheads Program, PE 0602747N. - Completed research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads.  FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as completed above.  FY 2011 Base Plans: - Continue all efforts of FY 2010. - Complete efforts associated with Energetics Applied Research.						
AIRCRAFT TECHNOLOGY		14.969	12.767	12.903	0.000	12.903

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The Aircraft Technology activity develops technologies for survivability and reduced observability, metrics are classified. It also develops new Naval air vehicle concepts and high impact, scaleable naval air vehicle technologies, such as - autonomous air vehicle command and control, helicopter and tiltrotor rotor and drive systems, aerodynamics, structures and flight controls for future and legacy air vehicles, which significantly increase the naval warfighter's capabilities, effectiveness, readiness, and safety, while reducing life cycle cost. This activity directly supports the Naval Aviation Enterprise Science and Technology Objectives and the Naval Science and Technology Strategic Plan, principally in the Platform Mobility Focus Area.</p> <p>The FY 2009 to FY 2010 decrease is due to the completion of several advanced concept and automonous system studies.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued development of survivability/reduced observables technology. Metrics are classified.</li><li>- Continued development of flight control, intelligent autonomy, command &amp; control, and multi-vehicle cooperation technologies for Unmanned Air Vehicle (UAV).</li><li>- Continued development of a Computational Fluid Dynamics (CFD) based integration system to maximize operational capability of autonomous aircraft by choosing optimal flight pattern for any environmental condition including low speed operations and brownout.</li><li>- Continued vertical lift technology investments.</li><li>- Initiated research in fixed wing aircraft/vertical lift/rotorcraft technology areas such as aeromechanics, propulsion, active rotor control for enhanced ship board operations, structural concepts compatible with shipboard operations, autonomous operations in the shipboard and austere environment, and innovative vehicle concepts for naval application.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate research in vertical lift aircraft /rotorcraft technology areas such as aeromechanics, propulsion, active rotor control for enhanced ship board operations, structural concepts compatible with shipboard operations, autonomous operations in the shipboard and austere environment, and innovative vehicle concepts for naval application.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all efforts of FY 2010.</p>						
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS		13.118	11.392	11.723	0.000	11.723
<p>Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats and to develop the capability to interdict underwater asymmetric threats to ships and infrastructure in harbors. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. (Asymmetric threat efforts are co-funded by PE 0602131M.) A goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual, multispectral electro-optical (EO), infrared (IR), radio frequency (RF), electro-magnetic (EM), visual and acoustic or chemical sensors/biosensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multispectral detection and distribution of specific threat information.</p> <p>Another goal of this activity is to develop a torpedo defense capability to fill Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats, including Four Torpedo Salvo Defense. This provides a capability to prevent any of the torpedoes, in up to four-torpedo salvos fired at high value units, from hitting those units.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity supports the Fleet and Force Protection FNC and includes support to Sea Shield and Sea Strike Pillars and FNC Enabling Capabilities for: Aircraft Integrated Self-protection Suite; Fortified Position Security; Advanced Electronic Sensor Systems for Missile Defense; and Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. Budget Activity 2 sensor efforts are co-funded by PEs 0602235N and 0602271N.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>Sensors &amp; Associated Processing</p> <ul style="list-style-type: none"><li>- Continued efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms.</li><li>- Completed design and fabrication of microfluidic nucleic acid extraction and enrichment methods and obtained funding for technology transfer.</li><li>- Continued efforts in biomimetic signal processing: panoramic periscope for submarines and temporal pattern recognition for Systems for Security Breaching Noise Detection.</li><li>- Continued efforts in bioinspired quiet, efficient and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics.</li><li>- Completed the development of low-cost, lightweight radar absorbing material (RAM) based on metallized cellulose in the form of fibers, fabric and paper.</li><li>- Completed design and testing of on-chip nucleic acid amplification and transfer technology.</li><li>- Continued studies to develop catalytic activity profile of bioactive coatings against chemical agents. Designed and initiated fabrication of coatings to degrade both, chemical and biological agents.</li><li>- Continued advanced concept development to integrate object recognition and tracking algorithms, machine vision, multiple networked video streams into different classes of EO/IR sensors within the Intelligent Video Surveillance FNC product (transferred from PE 0602131M).</li><li>- Completed the design and fabrication of self-reporting coatings for system failure detection.</li><li>- Continued FNC EC Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. This project will develop mission specific electro-optic/infrared sensors to detect,</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
classify, and determine the intent of potential terrorist and special operations force threats to ships and craft import and transiting restricted waters. - Transferred biomimetic signal processing efforts, including panoramic periscope and temporal pattern recognition for security breaching noise detection to PE 0602236N. - Transferred efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics to PE 0602236N. - Transferred efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms to PE 0602236N. - Completed the development of low-cost, lightweight RAM based on metallized cellulose in the form of fibers, fabric and paper. - Initiated the Countermeasures for Advanced Imaging Infrared (IIR) Guided Missiles FNC effort by initiating IIR threat model development. - Initiated the Countermeasures for Millimeter Wave Guided Missiles FNC effort by initiating requirements analysis. - Initiated the Multifunction Capabilities for Missile Warning Sensors FNC effort by commencing data collection and analysis. - Initiated efforts to design microfabricated system for 3-color fluorescence measurements using integrated waveguides. - Initiated effort to develop new, highly selective, preferential oxidation catalysts for the generation of power from the reformat gas purification process. - Initiated effort to develop aspheric gradient index optics. - Initiated the Helicopter Laser-Based Landing Aids FNC effort by commencing experimentation, data collection and analysis.  Underwater Platform Self-Defense - Continued development of low-cost, light weight swimmer detection and localization technologies.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued development of software encoded algorithms for the Anti-Torpedo Torpedo (ATT) sensor and controller that will enable ATT's to successfully engage torpedo salvoes of up to four attacking units.</p> <p><i>FY 2010 Plans:</i> Sensors &amp; Associated Processing - Continue all efforts of FY 2009, less those noted as completed above.</p> <p>Underwater Platform Self-Defense - Continue all efforts of FY 2009</p> <p><i>FY 2011 Base Plans:</i> Sensors &amp; Associated Processing - Continue all efforts of FY 2010. - Complete FNC EC Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. This project develops mission specific electro-optic/infrared sensors to detect, classify, and determine the intent of potential terrorist and special operations force threats to ships and craft in port and transiting restricted waters.</p> <p>Underwater Platform Self-Defense - Continue all efforts of FY 2010.</p> <p>In support of FNC (Force Projection Applied Research), perform the following efforts: - Initiate the development and application of emerging technologies that support delivery of Navy approved FNC enabling capabilities structured to close operational capability gaps in force projection. - Initiate the packaging of emerging force projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate the development of force projection technologies that support naval requirements identified within the Sea Shield and Sea Strike naval capability pillars as well as those applicable to specific naval platforms and those that apply across the naval enterprise.					
MISSILE DEFENSE (MD)  This activity describes Missile Defense S&T projects of the Sea Shield FNC program, and non-FNC-related Navy research. - Advanced Area Defense Interceptor (AADI) S&T planning effort for Navy - Marine Corps Air Directed Surface to Air Missile (ADSAM) live firing demonstration at White Sands Missile Range. Completed in FY 2009 with funding in PE 0603123N, the metric for AADI was execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability. - Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile (SM) future fleet air defense missile. Metrics will be to achieve SM performance requirements in specified tactical rain environments and achieve SM performance requirements in all specified electronic countermeasures environments. - Extended Distributed Weapons Coordination (EDWC) algorithms to extend DWC Automated Battle Management Aids (ABMA) functionality to include coordination of passive defense measures (emission control, use of decoys, maneuvering). Metric will be improved probability of negation (Pneg) against advanced ballistic & cruise missile anti-ship threats that may be susceptible to decoys and jamming. - Positive Control of Naval Weapons (PCNW) - additional technology upgrades for SM to enable forward relay, remote launch & potentially forward pass engagements. Metrics are classified. - Midcourse and Terminal Algorithms (MTA) for interceptor and associated weapon system enhancements to defeat advanced anti-ship missile threats with high confidence. Specific metrics are classified. - Enhanced Lethality Guidance Algorithms (ELGA) to increase probability of kill versus an expanded threat set including ASBMs and advanced ASCMs. Metrics for this project will be classified.	12.872	11.166	9.898	0.000	9.898

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Enhanced Maneuverability Missile Airframe (EMMA) technology for Navy shipboard missile systems to intercept highly agile maneuvering ASCMs and ASBMs. Metrics for this project will be classified.</p> <p>- Integrated Active &amp; Electronic Defense (IAED) technology basis for response combinations of active and electronic weapons &amp; systems to optimize Pneg against ASBMs and ASCMs, including potential interactions. Metrics will be classified.</p> <p>- Non-FNC-related investigation of effects of charged particle layers on UHF to S-Band radars used to track space vehicles and initiate development of advanced electromagnetic decoy launchers and payloads.</p> <p>The FY 2009 through FY 2011 decrease represents the phased movement of EDWC, PCNW, and NII projects from Applied Research (6.2) to Advanced (6.3) Research as the technologies mature and prepare for acquisition.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Completed program to investigate effects of charged particle layers on UHF to S-Band radars used to track space vehicles.</li><li>- Continued NII project.</li><li>- Continued EDWC and PCNW efforts.</li><li>- Initiated MTA project efforts.</li><li>- Initiated development of advanced electromagnetic decoy launchers and payloads.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete EDWC, NII and PCNW development efforts that will be tested/demonstrated.</li><li>- Initiate ELGA and EMMA project efforts.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate IAED project effort.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
STOPPAGE OF LARGE SURFACE VESSELS AT SEA  The Chief of Naval Operations (CNO) in the Navy Strategic Plan (NSP) has specified that the Navy must combat Weapons of Mass Destruction (WMD) at sea and ashore. To support this requirement, the Navy must be able to temporarily stop ships that are suspected of carrying WMDs or their component materials. This activity addresses the development of key technologies that will enable the Navy to use non-lethal methods for temporarily stopping and delaying non-cooperative large, greater than 20 meters or 300 gross tons, vessels at sea that will not comply with voice commands or warning devices. The technologies will be deployable by ship or aircraft and should be capable of disabling the vessel at safe distances from high-valued assets and infrastructures.  Funding increase from FY 2009 - FY 2011 is due to large-scale demonstrations of various stages of the systems.  FY 2009 Accomplishments: - Completed evaluation of potential propeller entanglement device materials. - Completed propulsion drive-train damage predictions. - Completed assessment of delivery options for a large linear propeller entanglement device. - Completed component level proof-of-concept demonstration for externally inhibiting seawater cooling flow to ship propulsion equipment. - Completed the identification and assessment of potential commercial maritime vessel electronic vulnerabilities within representative propulsion and maneuvering control systems. - Completed scaled component level proof-of-concept testing for large vessel momentum reduction concept. - Initiated prototype development and fabrication for a full-scale propeller entanglement device. - Initiated design and fabrication of device and emplacement system to externally inhibit seawater cooling flow to ship propulsion equipment. - Initiated the evaluation of technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.	7.570	7.638	14.870	0.000	14.870

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated the design and evaluation of a full-scale large vessel momentum reduction device and delivery system.</li><li>- Initiated tactical system engineering and define the operational parameters for a large vessel momentum reduction device.</li><li>- Initiated analysis and modeling of hydrodynamic forces generated between a large vessel and much smaller intercept craft or Unmanned Surface Vehicle (USV).</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete prototype development and fabrication for a full-scale propeller entanglement device.</li><li>- Complete design and fabrication of device and emplacement system to externally inhibit seawater cooling flow to ship propulsion equipment.</li><li>- Complete the evaluation of technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.</li><li>- Complete the design and evaluation of a full-scale large vessel momentum reduction device and delivery system.</li><li>- Complete tactical system engineering and define the operational parameters for a large vessel momentum reduction device.</li><li>- Initiate full-scale demonstration of propeller entanglement prototype.</li><li>- Initiate development of a USV delivery capability for a device emplacement package to externally inhibit seawater cooling flow to ship propulsion equipment.</li><li>- Initiate development of an autonomous delivery and deployment capability for a device emplacement package to externally inhibit seawater cooling flow to ship propulsion equipment.</li><li>- Initiate test and evaluation of delivery systems for technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.</li><li>- Initiate design and fabrication of a full-scale system capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate fabrication of a full-scale demonstration system for a large vessel momentum reduction device.</p> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete full-scale demonstration of propeller entanglement prototype.</li><li>- Complete development of a USV delivery capability for a device emplacement package to externally inhibit seawater cooling flow to ship propulsion equipment.</li><li>- Complete development of an autonomous delivery and deployment capability for a device emplacement package to externally inhibit seawater cooling flow to ship propulsion equipment.</li><li>- Complete test and evaluation of delivery systems for technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.</li><li>- Complete design and fabrication of a full-scale system capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.</li><li>- Complete fabrication of a full-scale demonstration system for a large vessel momentum reduction device.</li><li>- Complete analysis and modeling of hydrodynamic forces generated between a large vessel and much smaller intercept craft or Unmanned Surface Vehicle (USV).</li><li>- Initiate a full-scale demonstration of USV delivery and autonomous deployment of a device to externally inhibit seawater cooling flow to ship propulsion equipment.</li><li>- Initiate a full-scale dynamic demonstration of a system capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems.</li><li>- Initiate demonstration of a full-scale system for a large vessel momentum reduction device.</li></ul>						
SURFACE SHIP & SUBMARINE HULL MECHANIC & ELECTRICAL (HM&E)  Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), and advanced electrical power systems. Signature reduction addresses electromagnetic, infrared, and acoustic signature tailoring, both topside and		78.753	45.899	55.934	0.000	55.934

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<p>underwater. Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Hydromechanics addresses hydrodynamic technologies, including the signature aspects of the hull-propulsor interface and maneuvering. Distributed intelligence for automated survivability addresses both the basic technology of automating damage control systems, as well as, distributed control of systems utilizing self-healing capability. Advanced electrical power systems efforts address electrical and auxiliary system and component technology to provide improvement in energy and power density, operating efficiency and recoverability from casualties. Advanced Naval Power efforts include: Compact Power Conversion Technologies that reduce the cost of high power conversion equipment required to enable more-electric and all-electric ships. This activity also supports the Overseas Contingency Operations (OCO) Counter IED - Extramural activity which supports applied research for force protection of Naval platforms. Technologies are being developed that focus on prediction, prevention, detection, neutralization, and mitigation of improvised explosive devices in the maritime/littoral environment.</p> <p>The funding decrease from FY 2009 to FY 2010 is due to the completion of the energy and power technology initiative that accelerated research in the following Energy and Power efforts: Distribution/Control and Alternative Energy efforts, Energy Storage and Power Generation efforts and the Medium Voltage Direct Current (MVDC) architecture efforts in support of the Next Generation Integrated Power System (NGIPS) Roadmap efforts. The decrease also represents the phased movement of Future Naval Capability Enabling Capabilities Compact Power Conversion Technologies from Applied (6.2) to Advanced (6.3) Research as the technologies mature and prepare for transition to acquisition. The funding increase from FY 2010 to FY 2011 is due to the start up and initiation of modeling of hydroacoustics of turbulence-propulsor interaction; the effort on exploitation of polymers for the deflection of dissipation of shock wave impact on ship and submarine hull structures; transition of small scale hardware-in-the-loop demonstrator to the academic community for challenge problem formulation</p>						

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and demonstrations of developed model based reasoning control algorithms on full scale hardware test beds.  FY 2009 Accomplishments: Survivable Platforms - Reduced Signatures - Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines. - Continued mmWave Signatures measurement to identify key signature characteristics. - Continued Alternating Current (AC) propagation experiments. - Continued the next generation Infrared Electro-Optic Visual (IR/EO/VIS) model for surface ships by development of mitigation strategy supporting low observable infrared platforms, development of supporting physics, and prototype measurement techniques. - Continued development of quiet control surface design tool based on control surface flow noise studies. - Continued IR and radar detectability prediction capability. - Continued surface ship super-conductive degaussing with laboratory demonstration loop for Electromagnetic (EM) field accuracy measurements and control methods. - Continued testing on Advanced Electric Ship Demonstrator (AESD) to assess energy propagation and acoustic radiation mechanisms and to develop mitigation concepts for surface ships. - Continued IR assessment of two advanced treatments. - Continued first of a series of IR validation experiments and critical sensitivity analysis. - Continued Improved Corrosion Related Magnetic (CRM) Field Prediction Model to design compensation systems to reduce ship's CRM signature. - Continued assessment of ship biostatic Radar Cross Section (RCS). - Continued large-scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion. - Continued experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of modeling methods and noise control concepts for modular/reconfigurable submarine architectures.</li><li>- Continued investigation into hull treatment concepts for acoustic signature/vibration control for surface ships.</li><li>- Continued development of advanced RF metamaterials for platform signature control.</li><li>- Continued development of LPI technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems.</li><li>- Continued development of modeling methods and noise control concepts for modular/reconfigurable submarine architectures.</li><li>- Continued investigation into hull treatment concepts for acoustic signature/vibration control for surface ships.</li><li>- Continued development of advanced RF metamaterials for platform signature control.</li><li>- Continued development of LPI technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems.</li><li>- Completed testing on AESD to assess energy propagation and acoustic radiation mechanisms and to develop hull treatment concepts for surface ships.</li><li>- Completed experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction.</li><li>- Completed CRM Field Prediction Model with final validation by measurement of full scale ship to verify CRM Field Prediction against actual Impressed Current Cathodic Protection (ICCP) system layout for measured ship and magnetic/electric fields measured at Navy Magnetic Silencing Range Facility.</li><li>- Initiated development of signature modeling approaches for electric actuation and alternate electric drive system architectures.</li><li>- Initiated development of Low probability Intercept (LPI) technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems.</li></ul> Survivable Platforms - Hull Life Assurance						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of global surface wave measurement capability for ship models.</li><li>- Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy).</li><li>- Continued development of structural analysis codes describing failure mechanism of sandwich composites.</li><li>- Continued Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia.</li><li>- Continued Joint US/Japan Advanced Hull Materials &amp; Structures Technology (AHM&amp;ST) addressing hybrid hull concept and hybrid (steel/composite) joints in ship construction.</li><li>- Continued composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures.</li><li>- Continued effort on an advanced class of polymers as a follow-on to current ERC for application against advanced threats, Overseas Contingency Operations (OCO).</li><li>- Continued Payload Implosion and Platform Damage Avoidance efforts.</li><li>- Continued development of reliability-based recoverability methods for assessing damaged ship structures.</li></ul> <p>Survivable Platforms - Distributed Intelligence for Automated Survivability</p> <ul style="list-style-type: none"><li>- Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems.</li><li>- Continued research into advanced HM&amp;E system reconfiguration approaches, including agent-based control systems and algorithms, and model-based reasoning.</li><li>- Initiated Second Generation distributed systems model development.</li><li>- Initiated demonstration of real-time modeling of multiple distributed systems - utilizing small scale demonstrator.</li><li>- Initiated demonstration of Genetic Algorithm(s) for determining optimal distributed system control strategy.</li><li>- Initiated development of a hardware in-the-loop small scale demonstrator for fluid/thermal/electrical distributed systems.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated development of Survivability Analysis Algorithms Operable on a Total Ship Modeling Environment.</p> <p>Advanced Platforms - Advanced Platform Concepts and Designs</p> <ul style="list-style-type: none"><li>- Continued validation of asymmetric hull forms with experimental data.</li><li>- Continued development of analytical models to further define submarine modular hull concepts.</li><li>- Continued development of reliability based design and structural analysis code development.</li><li>- Continued development design tools for integrated antenna and composite topside.</li><li>- Continued circulation control analysis for three-dimensional flow effects.</li><li>- Continued aperstructures microwave communication system.</li><li>- Continued concept for Ultra High Frequency (UHF)/Very High Frequency (VHF) aperstructures opportunistic array (Advanced Hull-form Inshore Demonstrator - AHFID).</li><li>- Continued development of methods for determining reliability and vulnerability of aluminum ship structures.</li></ul> <p>Advanced Platforms - Hydromechanics</p> <ul style="list-style-type: none"><li>- Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback).</li><li>- Continued the validation of circulation control and advanced control surfaces with experiments.</li><li>- Continued to investigate improved maneuvering simulation capability for submarines.</li><li>- Continued validation of Reynolds Average Navier-Stokes (RANS) code for advanced waterjet propulsor performance predictions.</li><li>- Continued development of two-phase flow waterjet concept, Detached Eddy Simulation (DES) method for crashback prediction and numerical prediction method(s) of waterjet cavitation.</li><li>- Continued modeling of turbulent flow interaction with propeller Leading Edge (LE) and Trailing Edge (TE) and modeling and simulation of rough-wall boundary layer noise.</li><li>- Continued development of podded propulsor design/analysis tools.</li><li>- Continued prediction and validation of damaged stability and capsize.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued non-body-of-revolution tool development for advanced submarine configurations.</li><li>- Continued the multi-platform interaction analysis and tool development.</li><li>- Completed development of two-phase flow waterjet concept.</li><li>- Completed prediction and validation of unconstrained capsizes using advanced codes.</li></ul> <p>Advanced Naval Power Systems</p> <ul style="list-style-type: none"><li>- Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-based, zonal-electrical power system that reconfigures within 10 milliseconds.</li><li>- Continued designing software for the system manager for the Universal Control Architecture (UCA).</li><li>- Continued development of thermal management technology for shipboard power distribution.</li><li>- Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications.</li><li>- Continued improvements in electrical component and device technology allowing a reduction in motor propulsion and motor controllers weight and volume.</li><li>- Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation.</li><li>- Continued multi-year program to directly convert thermal energy to electricity. Such a capability would allow elimination of the steam cycle on an electric warship.</li><li>- Continued studies of alternative cooling systems for future shipboard radar systems.</li><li>- Continued development of structural macroscopic 3-dimensional battery.</li><li>- Continued development of pulsed power technologies to include pulsed alternators and capacitors.</li><li>- Continued electromechanical actuator noise source characterization activities.</li><li>- Continued torque measurements on reduced scale models in support of electromechanical actuators.</li><li>- Continued control surface actuator project focused on the technologies needed to define the design space for control surface actuators supporting submarines.</li><li>- Continued development of automated HVAC system architectures for future Naval platforms.</li><li>- Continued development of common universal stator design to accommodate varying rotor topologies to improve affordability of motor design and development.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued the computational design, synthesis and evaluation of new, high capacity, high-rate anode materials for Li-ion batteries.					
Acquisition Workforce Fund: - Funded DoD Acquisition Workforce Fund.					
FY 2010 Plans: Survivable Platforms - Reduced Signatures - Continue all efforts of FY 2009, less those noted as completed above. - Complete mmWave Signatures assessments to identify key signature characteristics. - Complete IR validation experiments and critical sensitivity analysis. - Complete testing on AESD to develop hull treatment coverage prediction capability for surface ships. - Initiate development of advanced special materials for hemispherical signature control. - Initiate scientific study of advanced passive EM signature control technologies. - Initiate development of next generation of evolving threat sensor systems.					
Survivable Platforms - Hull Life Assurance - Continue all efforts of FY 2009.					
Survivable Platforms - Distributed Intelligence for Automated Survivability - Continue all efforts of FY 2009. - Complete development of a hardware in-the-loop small scale demonstrator for fluid/thermal/electrical distributed systems.					
Advanced Platforms - Advanced Platform Concepts and Designs - Continue all efforts of FY 2009.					
Advanced Platforms - Hydromechanics					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Initiate full-scale circulation control bow planes design and construction for at-sea test.</li><li>- Initiate prediction and validation of damaged stability and capsize for advanced hulls and codes.</li></ul> <p>Advanced Naval Power Systems</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete preliminary designs of control surface actuator systems.</li><li>- Complete common universal stator design to accommodate varying rotor topologies to improve affordability of motor design and development.</li><li>- Initiate detailed design and breadboard demonstration of control surface actuator systems.</li></ul> <p>Surface Ship &amp; Submarine HM&amp;E Applied Research</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete development of heterojunction power switching devices.</li><li>- Complete the computational design, synthesis and evaluation of new, high capacity, high-rate anode materials for Li-ion batteries.</li></ul> <p>FY 2011 Base Plans:</p> <p>Survivable Platforms - Reduced Signatures</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Initiate advanced EM modeling tools development and validation.</li><li>- Initiate next generation deckhouse integration technology development.</li><li>- Initiate modeling of hydroacoustics of turbulence-propulsor interaction.</li></ul> <p>Survivable Platforms - Hull Life Assurance</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate effort on exploitation of polymers for the deflection and dissipation of shock wave impact on ship and submarine hull structures.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Survivable Platforms - Distributed Intelligence for Automated Survivability - Continue all efforts of FY 2010. - Complete initial demonstration of real-time modeling of multiple distributed systems - utilizing the small scale demonstrator. - Complete development of a hardware in-the-loop small scale demonstrator for fluid/thermal/electrical distributed systems. - Complete Second Generation distributed systems model development. - Initiate the transition of the small scale hardware-in-the-loop demonstrator to the academic community for challenge problem formulation. - Initiate demonstration of the developed model based reasoning control algorithms on full scale hardware test beds.						
Advanced Platforms - Advanced Platform Concepts and Designs - Continue all efforts of FY 2010.						
Advanced Platforms - Hydromechanics - Continue all efforts of FY 2010. - Complete optimization for waterjet-hull interaction. - Complete tip-vortex cavitation inception and scaling modeling. - Complete modeling of shock performance on composite propeller. - Initiate modeling of performance of composite propellers in extreme maneuvers.						
Advanced Naval Power Systems - Continue all efforts of FY 2010, less those noted as completed above. - Complete detailed design and breadboard demonstration of control surface actuator systems. - Complete electromechanical actuator noise source characterization activities. - Complete torque measurements on reduced scale models in support of electromechanical actuators.						

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
- Initiate fabrication of scaled control surface actuator systems under the Future Naval Capabilities (FNC) program.  Surface Ship & Submarine HM&E Applied Research - Continue all efforts of FY 2010, less those noted as completed above.											
Accomplishments/Planned Programs Subtotals						131.478	90.978	107.448	0.000	107.448	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<u>Line Item</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011 Base</u>	<u>FY 2011 OCO</u>	<u>FY 2011 Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• 0603123N: <i>FORCE PROTECTION ADVANCED TECHNOLOGY</i>	32.668	44.995	40.818	0.000	40.818	36.487	24.714	6.843	0.000	0.000	186.525
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> This PE supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.  Specific examples of metrics under this PE include: - Increase the hydrodynamic efficiency of current hull designs by 5% by FY 2010. - Reduce electromagnetic vulnerability of ship hulls by 50% by FY 2011. - Torpedo defense thresholds will be validated by modeling and simulation to satisfy the overall system performance specification of a Probability of Survival (PS) of the US Navy platform as specified in the draft Capabilities Development Document (CDD) for Surface Ship Torpedo Defense.											

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<p>- Additional metrics are included within the Missile Defense Activity description.</p>		

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<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	55.150	55.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	241.702
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Advanced Battery System For Military Avionics Power Systems <i>FY 2010 Plans:</i> This effort supports Advanced Battery System for Military Avionics Power Systems research.							0.000	1.593			
Congressional Add: Advanced Composite Manufacturing For Composite High-Speed Boat Design <i>FY 2010 Plans:</i> This effort supports Advanced Composite Manufacturing for Composite High-Speed Boat Design research.							0.000	1.593			
Congressional Add: Advanced Energetics Initiative <i>FY 2010 Plans:</i> This effort supports Advanced Energetics Initiative research.							0.000	3.983			
Congressional Add: Carbon Composite Thin Films For Power Generation And Energy Storage							0.000	1.593			

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Carbon Composite Thin Films for Power Generation and Energy Storage research.		
Congressional Add: Center For Autonomous Solar Power-Supercapacitors For Integrated Power Storage <i>FY 2010 Plans:</i> This effort supports Center for Autonomous Solar Power-Supercapacitors for Integrated Power Storage research.	0.000	3.983
Congressional Add: Energetic Nano-Materials Agent Defeat Initiative <i>FY 2010 Plans:</i> This effort supports Energetic Nano-Materials Agent Defeat Initiative research.	0.000	1.593
Congressional Add: Fuel Efficient, High Specific Power Free Piston Engine For Ussvs <i>FY 2010 Plans:</i> This effort supports Fuel Efficient, High Specific Power Free Piston Engine for USSVs research.	0.000	1.593
Congressional Add: Lithium Ion Storage Advancement For Aircraft Applications <i>FY 2010 Plans:</i> This effort supports Lithium Ion Storage Advancement for Aircraft Applications research.	0.000	1.992
Congressional Add: Multi-Mission Unmanned Surface Vessel	0.000	1.992

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Multi-Mission Unmanned Surface Vessel research.		
Congressional Add: Non-Traditional Ballistic Fiber And Fabric Weaving Application For Force Protection <i>FY 2010 Plans:</i> This effort supports Non-Traditional Ballistic Fiber and Fabric Weaving Application for Force Protection research.	0.000	1.992
Congressional Add: Hybrid Power Systems <i>FY 2010 Plans:</i> This effort supports Hybrid Power Systems research.	0.000	1.992
Congressional Add: Proton Exchange Membrane Fuel Cell For Underwater Vehicles <i>FY 2010 Plans:</i> This effort supports Proton Exchange Membrane Fuel Cell for Underwater Vehicles research.	0.000	1.593
Congressional Add: Advanced Simulation Tools for Aircraft Structures Made of Composite Materials <i>FY 2009 Accomplishments:</i> This effort supported the development and validation of tools and guidelines for the simulation of the structural and strength responses of airframe components made of fiber-reinforced composites, an area where the use of advanced computer-aided engineering technology is particularly important.	1.197	1.593

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> Continue this effort to support the continuation of Advanced Simulation Tools for Composite Aircraft Structures research.		
Congressional Add: Alternative Energy Research  <i>FY 2009 Accomplishments:</i> This effort supported research into the potential for this effort to develop alternative energy sources for military applications and to analyze the effects of alternative fuels on military engines and equipments.  <i>FY 2010 Plans:</i> Continue this effort to support the continuation of Alternative Energy Research.	19.945	18.423
Congressional Add: Deputee-High Powered Microwave Non-Lethal Vehicle/Vessel Engine Disabling  <i>FY 2009 Accomplishments:</i> This effort supported the demonstration of the capability to counter, in an effective, non-lethal fashion, marine vessel and ground vehicle threats.	1.596	0.000
Congressional Add: Harbor Shield-Homeland Defense Port Security Initiative  <i>FY 2009 Accomplishments:</i> This effort supported the improvement of the defense of harbors against asymmetric attack by detecting threats at safe standoff distances.  <i>FY 2010 Plans:</i> Continue this effort to support the continuation of Harbor Shield - Homeland Defense Port Security Initiative research.	3.490	1.593

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: High Speed ACRC & Composites Sea Lion Craft Development <i>FY 2009 Accomplishments:</i> This effort supported the validation of potential weight savings from the previous aluminum craft currently being demonstrated by NSWCC Combatant Craft and from the integrated low observable antennas.	1.995	0.000
Congressional Add: High Power Density Propulsion and Power for USSVs <i>FY 2009 Accomplishments:</i> This effort supported the demonstration of a heavy fuel engine with significant increase in power-to-weight ratio and improvement in specific fuel consumption.	1.596	0.000
Congressional Add: High Strength Welded Structures <i>FY 2009 Accomplishments:</i> This effort supported the development of a lighter and less expensive metal to be used for ship hulls.	0.798	0.000
Congressional Add: Integration of Electro-Kinetic Weapons into Next Generation of Navy Ships <i>FY 2009 Accomplishments:</i> This effort supported the development of ships' electrical systems architecture and technologies to support the integrations of electro-kinetic weapons systems into naval ships.  <i>FY 2010 Plans:</i> Continue this effort to support the continuation of Integration of Electro-Kinetic Weapons Into Next Generation Navy Ships research.	4.487	3.983
	1.596	0.000

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Lithium Batteries  <i>FY 2009 Accomplishments:</i> This effort supported research into the potential to replace existing aircraft batteries with lithium ion batteries exhibiting lighter weight, smaller volume, and enhanced performance.		
Congressional Add: Lithium-Ion Cell Development with Electro Nano Materials  <i>FY 2009 Accomplishments:</i> This effort supported the use of nanomaterials to develop and demonstrate lithium ion batteries exhibiting lighter weight, smaller volume, and enhanced performance compared with current battery technologies.	3.988	0.000
Congressional Add: Lithium-Sulfur Chemistry Validation for Sonobuoy Application  <i>FY 2009 Accomplishments:</i> This effort supported research into the development of replacement Lithium/Sulfur Dioxide batteries at a lighter weight, taking up less space with extended shelf-life.	1.596	0.000
Congressional Add: Magnetic Refrigeration Technology  <i>FY 2009 Accomplishments:</i> This effort supported research development of magnetic refrigeration that could enable improved thermal management of the complex, temperature sensitive electrical and electronic systems increasingly installed onboard Naval sea, air and ground platforms.  <i>FY 2010 Plans:</i> Continue this effort to support the continuation of Magnetic Refrigeration Technology for Naval Applications research.	2.394	3.983

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Mk V.1 MAKO for Improved Signature and Weight Performance <i>FY 2009 Accomplishments:</i> This effort supported research into the potential of reducing the Mk V.1 structural weight and improving signature characteristics through the use of lightweight composite materials.	1.995	0.000
Congressional Add: Naval Special Warfare 11m RIB Replacement Craft Design <i>FY 2009 Accomplishments:</i> This effort supported the development of technologies to design high speed planing craft that minimize the wave slap shock on passengers and crew, enabling SOF forces to be more physically conditioned to execute their mission following a transit over rough waters.	0.798	0.000
Congressional Add: PMRF Force Protection Lab <i>FY 2009 Accomplishments:</i> This effort supported the development, integration, and evaluation of force protection and security technologies at the Pacific Missile Range Facility (PMRF). The effort includes integration of advanced sensor systems, novel sensor and data fusion processes, behavior modeling and analysis, and data mining and knowledge extraction techniques.	1.995	0.000
Congressional Add: Planar Solid Oxide Fuel Cell System Demonstration at UTC SimCenter <i>FY 2009 Accomplishments:</i> This effort supported the development of modeling and simulation capabilities to describe solid oxide fuel cells to improve performance for future military applications.	3.490	0.000
	0.997	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602123N: <i>Force Protection Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Shipboard Production of Synthetic Aviation Fuel  <i>FY 2009 Accomplishments:</i> This effort supported the development of a shipboard logistics or aviation fuel production capability that is proven to be more economical and safer than the existing land based fueling capabilities. In addition, shipboard production of synthetic fuel will lessen dependency on petroleum-based resources.		
Congressional Add: Standoff Explosive Detection System (SEDS)  <i>FY 2009 Accomplishments:</i> This effort supported the development of a scanning laser sensor for real-time, standoff, remote detection of trace particle contamination of all types of explosives (military, commercial and improvised) on vehicles, personnel and suspicious objects.	1.197	0.000
Congressional Adds Subtotals	55.150	55.067
<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A		
<b><u>D. Acquisition Strategy</u></b> N/A		
<b><u>E. Performance Metrics</u></b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	43.499	45.607	43.776	0.000	43.776	45.099	46.331	47.415	48.429	Continuing	Continuing
3001: Marine Corps Landing Force Tech	37.017	39.134	43.776	0.000	43.776	45.099	46.331	47.415	48.429	Continuing	Continuing
9999: Congressional Adds	6.482	6.473	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23.539
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&amp;T) Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This PE is organized into nine activities which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts, Technology Assessment and Roadmapping, and the Littoral Combat/Power Projection (LC/PP) FNC. The primary objective of this PE is to develop and demonstrate the technologies needed to meet the Marine Corps' unique responsibility of training and equipping the Marine Air/Ground Task Force (MAGTF) for Expeditionary Maneuver Warfare. This PE provides the knowledge base to support Advanced Technology Development (6.3) and is the technology base for future expeditionary warfare capabilities. This PE supports the Expeditionary Force Development System of the Marine Corps Combat Development Command (MCCDC) and responds directly to the Marine Corps Science and Technology (S&amp;T) process as well as supporting related Littoral and Expeditionary Maneuver Warfare capabilities developed by the Navy's Mission Capability Program. The Future Naval Capabilities (FNC) process is supported and funds are programmed accordingly. The FNC program explores and demonstrates technologies that enable Sea Strike, Sea Shield, Sea Basing, FORCEnet and Force Health Protection pillars, Space, Naval Expeditionary Maneuver Warfare and the Enterprise and Platform Enablers. The FNC program is composed of Enabling Capabilities (ECs) which develop and deliver quantifiable products (i.e., prototype systems, knowledge products, and technology improvements) in response to validated requirements for insertion into acquisition programs of record after meeting agreed upon exit criteria within five years. The core 6.2 program also supports Discovery and Invention (D&amp;I) and Innovation and Transformation (I&amp;T). Within the Naval Transformation Roadmap, this investment will achieve key transformational capabilities required by the Sea Power 21 Pillars, as well as enable Ship to Objective Maneuver (STOM), Persistent Intelligence, Surveillance and Reconnaissance and Overseas Contingency Operations (OCO).</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech	
<p>In FY 2010 preparation efforts continue in areas of technology that are ready for major, integrated technology demonstration. All technical work is being coordinated throughout DoD on these demonstrations. In areas such as vehicle technology demonstrations, the goal is to deliver multiple classes of advanced technology ground vehicle demonstrations leading to new classes of protective, efficient, ground vehicles.</p> <p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602131M: <i>Marine Corps Lndg Force Tech</i>				<b>PROJECT</b> 3001: <i>Marine Corps Landing Force Tech</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
3001: <i>Marine Corps Landing Force Tech</i>	37.017	39.134	43.776	0.000	43.776	45.099	46.331	47.415	48.429	Continuing	Continuing
<b>A. Mission Description and Budget Item Justification</b> This project is organized into nine activities which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts; Technology Assessment and Roadmapping; and the Littoral Combat/Power Projection (LC/PP) FNC. The seven Expeditionary Warfighting Areas support the Discovery and Invention (D&I) and the Innovation and Transformation (I&T) investment. The LC/PP FNC supports the Exploitation and Deployment (E&D) investment.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4)  This activity supports S&T investment in Command and Control and is focused in three main areas. (1) Implementing the FORCEnet concept. FORCEnet is the operational construct and architectural framework for naval warfare in the information age that integrates warriors, networks, command and control, and weapons into a networked, distributed, combat force that is scalable across all levels of conflict from the seabed to space and sea to land. The Marine Corps instantiation of FORCEnet is Marine Air Ground Task Force Command and Control (MAGTF C2), with technologies to exchange data and information with and among distributed tactical forces. (2) Developing decision support systems that enable warfighters to take advantage of the FORCEnet and MAGTF C2 and tactically extend Net-Enabled Command and Control (NECC) for shared situational awareness. (3) Providing effective combat identification of enemy combatants, friendly forces, and non-combatants. Activities in this activity provide technologies for secure, robust, self-forming, mobile communications networks distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture. Marine Corps specific efforts include power management, low detect ability, size and weight constraints, and interoperability within the joint environment.						2.870	3.323	3.851	0.000	3.851	

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The FY 2009 to FY 2010 increase in funding results from the acceleration of efforts to complete and transition Adaptive Networking Technologies efforts.						
The FY 2010 to FY 2011 increase in funding results from accelerating and completing the transition of C4 needs in Adaptable Antennas Technologies, Field Programmable Gate Array Communications Architectures, and Information on Demand programs.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Initiated development of C3 for the Distributed Operations Marine technologies. This includes development of technologies to allow small units to share Position and Location Information (PLI) in GPS-denied or restricted environments thereby enhancing current blue force situational awareness.</li><li>- Initiated development of urban/restricted environment communications technologies.</li><li>- Initiated new efforts in Over-the-Horizon Communications which include the development of an airborne software-defined communications, networking, Electronic Signals Intelligence (ELINT) and Electronic Warfare (EW) capability.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete Free Space Optical Communications Technologies and Adaptive Networking Technologies efforts.</li><li>- Initiate Position Location Technologies.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete Adaptable Antennas Technologies, Field Programmable Gate Array Communications Architectures, and Information on Demand efforts. (Relates to FY 2009 plan to initiate new efforts in Over-the-Horizon Communications).</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate Cognitive Networking Technologies, Mobile Security Architecture Technologies, and Small Unit Blue Force tracking/Position Location Information/Combat Identification Technologies efforts.					
FIREPOWER  This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: Fuze, fire control, launch/propulsion, lethality, and accuracy.  The FY 2009 to FY 2010 decrease in funding results from delays due to obtaining programmatic milestone approvals in the Targeting and Engagement and Precision Target Location efforts.  The FY 2010 to FY 2011 increase in funding is due to enhanced E&D efforts for precision urban attack. The efforts address technologies needed to acquire, track, and designate Forward Observer (FO) identified targets, from an Unmanned Aircraft System (UAS) using micro pulse laser designator (MPLD) energy, for urban (and other) terrain attack by mortar rounds with advanced trajectory shaping capabilities.  FY 2009 Accomplishments: - Continued development of a concept for an insensitive munition propulsion system to enable firing a shoulder launched rocket from an enclosed space. - Continued development of enhanced mortar munitions for more effective fire support. - Continued investigation of the scalability of variable effects conventional munitions technology for improving firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare. - Continued development of collaborative fires coordination technologies. - Continued development of precision fires engagement technologies. - Initiated and continue development of Distributed Operations Precision Engagement collaborative fires coordination technologies.	4.095	3.590	4.314	0.000	4.314

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated expanded efforts in lightweight weapons and ammunition (mortars, crew served weapons, ammunition and packaging).</li><li>- Initiated Targeting &amp; Engagement and Precision Target Location efforts that include Integrated Day/ Night Sight Technology.</li><li>- Initiated design and development of lightweight technologies that provide individual Marines enhanced capabilities to detect and identify man-size targets at least out to the maximum effective range of their personal weapons during all conditions (daylight, limited visibility, &amp; darkness) by integrating multiple capabilities into a single system.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Complete development of Non-Magnetic Azimuth Sensing technology.</li><li>- Complete development of eye-safe Micro Pulse Laser Designation technology.</li></ul>						
FORCE PROTECTION  This activity supports the Force Protection Thrust's applied research program. Technologies are being developed that focus on the following: Landmine avoidance, detection, and breaching/neutralization; Counter Improvised Explosive Devices; Counter Rocket, Artillery, Mortar, and Sniper; Technologies for improved protection for individuals including Marine Personnel Protective Equipment against blast, ballistic and blunt impact threats and in chemical, radiological, and biological environments; and physical installation and checkpoint security. Beginning in FY 2009, Mine Counter Measure (MCM) efforts are funded within this activity. Force Protection (FP) related technologies, including all MCM and counter Improvised Explosive Device (IED) related technology development are now reflected in this thrust area's submission.		3.701	4.186	4.764	0.000	4.764

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>FY 2009 reflects funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs,</li><li>- Personal protection materials,</li><li>- Personal power generation,</li><li>- Micro power sources, and</li><li>- Augmented reality</li></ul> <p>The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Force Protection activity are central to the integrated demonstration program.</p> <p>The FY 2009 to FY 2010 increase results from accelerating efforts required to complete a neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling rapid defeat of Passive InfraRed Sensor (PIR) devices from significant stand-off distances.</p> <p>The FY2010 to FY2011 increase results from accelerated efforts in personal protection - specifically, completion of multi-material fiber level modeling and simulation for ballistic fabric optimization and development.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>The following efforts transitioned from the Maneuver activity:</p> <ul style="list-style-type: none"><li>- Continued development of technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO). (Transitioned from Maneuver activity)</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection. (Transitioned from Maneuver activity)</li><li>- Continued spectral signature classification efforts for MCM applications.(Transitioned from Maneuver activity)</li><li>- Continued development of computational models to scale the effects of small-scale explosives tests to full-scale landmine explosions in order to study mine blast effects on advanced vehicle geometry.</li><li>- Continued technology development programs to address force protection personal protective equipment capability gaps.(Transitioned from Maneuver activity)</li><li>- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared). (Transitioned from Maneuver activity)</li><li>- Completed development of studies into mine signature classification.</li><li>- Completed development of modeling tools to accurately determine loading and fragmentation effects on targets from mine explosions.(Transitioned from Maneuver activity)</li><li>- Completed evaluation of low passive inter-modulation narrowband antennas and wideband antennas for potential use in detection methodologies.</li><li>- Initiated studies of sensor fields to identify and classify mine threats.</li><li>- Initiated evaluation of active wideband double notch filters for a wide spur-free dynamic range in specific frequencies of interest to cover a variety of threats.</li><li>- Initiated an Explosive Hazard Defeat for IED Neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling defeat of PIR devices from significant stand-off distances.</li><li>- Initiated Counter Rockets, Artillery, Mortars, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete magnetic and seismic portion of development of technologies to defeat side/top attack and advanced mine fuzes.</li><li>- Complete high-speed syntactic landmine detection algorithm development to support ground penetrating radars. (Relates to FY 2009 plan to continue development of technologies for stand-off detection and neutralization of mines, IEDs, and UXO).</li><li>- Complete Neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling defeat of PIR devices from significant stand-off distances.</li><li>- Complete vulnerability analysis of selected munitions and targets. (Relates to FY 2009 plan to initiate Counter Rockets, Artillery, Mortars, and Sniper efforts ).</li><li>-Initiate technology development efforts to detect and defeat incoming rocket, artillery, and mortar threats via non-kinetic means.</li><li>- Initiate multi-spectral protection efforts against battlefield directed energy weapons.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete spectral signature classification efforts for neutralization confirmation.</li><li>- Complete development of shape charge, safe and arm, and non-energetic launch and delivery technologies to support scaleable explosive neutralization. (Relates to FY 2009 plan to continue development of technologies for stand-off detection and neutralization of mines, IEDs, and UXO).</li><li>- Complete multi-material fiber level modeling and simulation for ballistic fabric optimization and development. (Relates to FY 2009 plan to continue technology development programs to address force protection personal protective equipment capability gaps).</li><li>- Initiate studies of sensor fields to identify and classify mine threats.</li></ul>						
FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING  This activity supports the planning and integration of technology development efforts across the entire PE. In conjunction with the Concepts Based Capabilities System and the Marine Corps Warfighting Laboratory, unique and novel concepts for advanced warfighting are developed and validated.		0.869	1.052	1.116	0.000	1.116

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Effectiveness analyses are conducted to identify the synergistic effects that can be achieved through the integration of emerging technology with innovative tactics, doctrine, and techniques. Technology assessments are conducted to determine the supporting technologies that have the highest impact across the warfare areas, and warrant further investment within this PE. Technology Roadmapping is conducted to help identify opportunities to leverage technology development within the Department of the Navy and the Department of Defense, as well as, with the commercial sector and university communities. The resultant technology investment strategy is developed and used to guide out-year technology development efforts.						
FY 2009 reflects funding for new assessments in Asymmetric/Irregular Warfare and Distributed Operations; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs, - Personal protection materials, - Personal power generation, - Micro power sources, and - Augmented reality The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies for force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.						
The FY 2010 to FY 2011 funding increase results from expanded assessments relative to how the Marine Corps supports the National Defense Strategy (NDS) and multinational efforts in Overseas Contingency Operations, the Long War and employment in the full Range Of Military Operations (ROMO).						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap. - Continued the integrated planning of concepts and technology development. - Continued development of the Expeditionary Maneuver Warfare Investment Strategy. - Continued Technology Assessments and Roadmapping within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the PE. - Continued Technology Assessment of the Combating Terrorism portfolio. - Continued assessment of the technical requirements of the Marine Corps Special Operations Command (MARSOC). - Initiated and continue assessments in Lightening the Marine's Load and Enhancing the Capabilities of the Marine Corps Rifle Squad. - Initiated assessments in Asymmetric / Irregular Warfare and Distributed Operations. - Initiated assessments of all new and emerging Counter Sniper Technologies. - Initiated new planning and integration of technology development efforts to meet imposing security threats that challenge our Nation.						
FY 2010 Plans: - Continue all efforts from FY 2009. - Complete the assessment of the technical requirements of the MARSOC. - Complete assessments of all new and emerging Counter Sniper Technologies. - Complete Technology Assessment of the Combating Terrorism portfolio. - Complete Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap. - Complete the integrated planning of concepts and technology development. - Complete development of the Expeditionary Maneuver Warfare Investment Strategy.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Complete Technology Assessments and Roadmapping within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the PE.</p> <p>- Initiate an assessment of the S&amp;T impacts of Marine Corps' concept of force employment to meet the need for counterinsurgency and building partnership capacity. How the Marine Corps supports the National Defense Strategy (NDS) and multinational efforts in the Global War on Terrorism/Long War will have long-term S&amp;T impacts.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all efforts from FY 2010, less those noted as completed above.</p> <p>- Complete the assessment of the Distributed Operations S&amp;T Strategic Focus Area and portfolios.</p> <p>- Complete the assessment of the DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems.</p>						
HUMAN PERFORMANCE, TRAINING AND EDUCATION		3.350	3.961	4.662	0.000	4.662
<p>This activity develops advanced training technology and technologies that enhance neural and cognitive aspects of human performance including cognitive task analysis, tactical decision-making, modeling, simulation, range instrumentation, and synthetic environment generation.</p> <p>The FY 2009 to FY 2010 funding increase results from accelerated efforts to complete and transition research into distributed operations peak neural and cognitive performance.</p> <p>The FY 2010 to FY 2011 funding increase results from accelerated development of squad-level team training mitigation strategies.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>- Continued research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued research on combat feeding and hydration.</li><li>- Continued research on physiological correlates for the strategic corporal assessment.</li><li>- Continued development into a Marine performance optimization model.</li><li>- Continued the development of training effectiveness measures and techniques as applied to disparate, multi-platform, multi-mission team training.</li><li>- Continued research into distributed operations peak neural and cognitive performance.</li><li>- Continued research into next generation survivability enhancement technologies.</li><li>- Continued studies into next generation physical performance enhancement methodologies and technologies.</li><li>- Completed evaluation of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during training.</li><li>- Completed research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for Military Operations in Urban Terrain (MOUT).</li><li>- Initiated the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert.</li><li>- Initiated development of training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition and expertise.</li><li>- Initiated additional Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations).</li><li>- Initiated Distributed Operations training system investigations to perceptual skills enhancement that lead to enhanced cognition and decision making.</li><li>- Initiated additional efforts to incorporate effects of nutrition and functional fitness into models and simulations in the Distributed Operations Virtual Toolkit.</li><li>- Initiated Advanced Mobile Assessment and Field Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile, rugged tools, algorithms, and models.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated a Mind-Body Integration Systems effort to improve team training by developing and validating Electroencephalogram (EEG) (and other physiological and performance measures) for use in assessing team performance, coordination, and cohesion in training environments.</p> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete Distributed Operations training system investigations to perceptual skills enhancement that lead to enhanced cognition and decision making.</li><li>- Complete research into distributed operations peak neural and cognitive performance.</li><li>- Initiate evaluations of asymmetric distributed learning techniques for distributed operations, language, and cultural training.</li><li>- Initiate development of team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.</li><li>- Initiate development of team training/immersive approaches towards language and culture training that incorporate foundational learning theories and other advanced educational methods.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Initiate development of squad-level team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.</li><li>- Initiate development of field team performance mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.</li></ul>					
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)  This activity develops ISR technologies for applications in future intelligence, surveillance, and reconnaissance. Technologies being pursued enhance situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information	1.912	2.217	2.571	0.000	2.571

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to decision-makers, especially those at the lower command levels. This includes complete future automation of options and persistent surveillance in support of distributed operations.						
The increases in funding from FY 2009 to FY 2010, as well as FY 2010 to FY 2011, are due to enhanced ISR Sensor Field efforts.						
FY 2009 Accomplishments: The following efforts transitioned from the C4ISR activity in FY 2009: <ul style="list-style-type: none"><li>- Continued development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.</li><li>- Continued development of low power consumption urban sensing technologies.</li><li>- Continued development of tagging, tracking and locating technologies to monitor adversary movement.</li><li>- Continued development of information on demand technologies to provide warfighter with the right information at the right time.</li><li>- Continued development of urban sensing technologies to detect weapons at distance.</li><li>- Continued development of adaptable enemy course of action engine to manipulate adversary decisions.</li><li>- Continued development of advanced tactical sensor technologies to improve unit awareness.</li><li>- Initiated and continue development of distributed information architecture technologies.</li><li>- Initiated and continue the decision prediction, manipulation, stimulation and learning detection capability to add tools that enable the warfighter to operate inside the OODA loop of an irregular actor. The Observe, Orient, Decide, Act (OODA) Loop provides a standard description of decision making cycles that is widely understood and accepted throughout the U.S. military.</li><li>- Initiated and continue development of a single integrated battlespace picture with tactical and strategic injects that begins to close the gap between ISR and C2.</li><li>- Initiated and continue Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated tagging, tracking, and locating technologies development to address development of multi-INT track continuity.</li><li>- Initiated development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes.</li><li>- Initiated efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2009.</li><li>- Complete development of urban sensing technologies to detect weapons at distance.</li><li>- Initiate new Sensor Fields efforts such as Nanotechnology Enabled Witness Fields, development of sensors that provide near real time decision support to distributed operations by detecting specific interactions, and nanotechnology efforts which offer the potential to revolutionize tactical sensors. To enable this capability, nanomaterials that change state in the presence of another nanomaterial will be developed.</li><li>- Initiate efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform.</li><li>- Initiate development of capabilities to integrate socio-cultural models of human behavior with the ability to forecast the processes of decision making through predictive forecasting models.</li><li>- Initiate development of approach to model and expose enemy networks, actions, and reactions through statistical models with techniques for probabilistic forecasting of behaviors of interest with consideration for open source information and conventional intelligence data sources.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate development of sensors that provide near-real-time decision support to distributed operations by detecting specific interactions utilizing nanotechnology.</li><li>- Initiate efforts to derive high resolution models of human networks statistically with associated behavior attributes.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2010, less those noted as completed above.</li><li>- Complete optical tag geolocation from a UAV effort.</li><li>- Complete development of advanced tactical sensor technologies to improve unit awareness by demonstrating the feasibility of voice recognition and facial identification from a battery powered processor.</li><li>- Initiate development of nanomaterials required to support small sensors that can "witness" environments (places and substances) as well as the proximity between specific people and places to verify information.</li><li>- Initiate work on specific nanomaterial triggers and receptors.</li><li>- Initiate work on new optical taggants with improved producibility.</li><li>- Initiate work on influencing, disrupting, and stimulating behavior by fusing high resolution models of decisions with models of human networks.</li></ul>						
LITTORAL COMBAT/POWER PROJECTION		11.230	9.750	9.800	0.000	9.800
This activity is aligned with the Sea Strike, Sea Shield, Sea Basing and FORCEnet and Expeditionary Maneuver Warfare (EMW) pillars as well as Force Health Protection and the Enterprise & Platform Enablers. It provides the capability for the demonstration and transition of technologies developed through the related Marine Corps S&T programs directly to an acquisition program of record.						
The funding profile reflects the alignment of the FNC program investments into ECs. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. The focus of the ECs within this PE will be on technology related to Urban, Asymmetric, Littoral and Expeditionary Operations. The related						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>science and technology development is of the highest importance to Marine Corps operations in Iraq, Afghanistan and the OCO. The technologies associated with these gaps are being pursued as part of an overall effort that addresses Sea Strike, Sea Shield, Sea Basing and FORCEnet and Expeditionary Maneuver warfare Capability Gaps. Warfighter Capability Gaps are made up of ECs and supporting products. This activity includes support to the Urban, Asymmetric Operations-related EC's for IED's, Modular Scalable Effects Weapons, Advanced Naval Fires Technology, Dynamic Target Engagement, Position Location Information, Transparent Urban Structures, Hostile Fire Detection and Response, Lightweight Protective Systems, and Lightening the Load of Dismounted Combatants.</p> <p>This activity also funds the Marine Corps participation in the Future Naval Capabilities(FNC) program. The additional funds are for the Expeditionary Fighting Vehicle Obstacle Detection System (EFV ODS) in order to complete prototype testing.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager.</li><li>- Continued development of integrated vehicle self-defense system to defeat incoming RPGs.</li><li>- Continued transparent urban structure 'see thru the wall', image and mapping technologies development.</li><li>- Continued modular scalable effects weapons technologies development.</li><li>- Continued development of an integrated company level Urban Sensor Suite. (Automated Control of Large Sensor Networks) (Transitions to PE 0602235N.)</li><li>- Continued detect and identify facilities technology development. (Transparent Urban Structures)</li><li>- Continued decision aids technology development. (Transparent Urban Structures)</li><li>- Continued indirect prototype technology development. (Modular Scalable Effects Weapon)</li><li>- Continued development of Modular Scalable Effects weapons technologies. (Concurrent funding in PE 0603640M.)</li></ul>						

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602131M: Marine Corps Lndg Force Tech		PROJECT 3001: Marine Corps Landing Force Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of counter Improvised Explosive Device (IED) technologies. (Concurrent funding in PE 0603640M.)</li><li>- Continued development of tactical urban breaching technologies. (FY09 funding in PE 0603640M.)</li><li>- Completed development of land mine countermeasure insensitive munitions technology.</li><li>- Completed development of tactical ISR data structures and pattern recognition algorithms.</li><li>- Completed advanced concept development to alert approaching targets with an unambiguous warning that, if ignored, will clearly demonstrate hostile intent of the approaching target. (Realigned from PE 0602123N.)</li><li>- Completed efforts to provide urban direction finding of Radio Frequency (RF) emitters from moving platforms. (Concurrent funding in PE 0603640M.)</li><li>- Completed effort in Distributed Common Ground/Surface System (DCGS) that involves the migration of tactical intelligence systems (sensor networks) to a net-ready architecture and the development of enterprise services that translate this data.</li><li>- Completed development of target acquisition architecture, information exchange, connectivity and interoperability of target hand-off, fire control, and coordination systems. (Concurrent funding in PE 0603640M.)</li><li>- Completed design and test of hostile fire detection and counter-fire system (GUNSLINGER).</li><li>- Completed development of integrated vehicle self-defense system technologies to defeat incoming Rocket Propelled Grenades (RPGs). (Concurrent funding in PE 0602782N.)</li><li>- Completed development and integration of network monitoring and management tools technology and transition to acquisition. (Concurrent funding in PE 0603782N.)</li><li>- Completed integration and demonstration of innovative relays Beyond Line Of Sight (BLOS) in the areas of wideband communications and advanced modular systems. (Concurrent funding in PE 0603782N.)</li><li>- Completed development of algorithms and initiated modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations; provide algorithms to MARCORSYSCOM Program Manager (PM) INTEL. (Concurrent funding in PE 0603782N.)</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div><div><div>- Completed Expeditionary Fighting Vehicle (EFV) obstacle detection subsystem design, integrated subsystems and prepared for demonstration.</div><div>- Initiated development of individual Warfighter protection technologies. (Concurrent funding in PE 0603640M).</div><div>- Initiated development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. (Concurrent funding in PE 0603640M and 0603236N).</div></div><div><div>FY 2010 Plans:</div><div><div>- Continue all efforts of FY 2009.</div><div>- Complete development and transitioning of improved fire control technologies based on small-scale hardened non-magnetic azimuth sensor to improve timeliness and accuracy of mortars/howitzers. (Concurrent funding provided by PE 0602114N.)</div></div></div><div><div>FY 2011 Base Plans:</div><div><div>- Continue all efforts of FY 2010, less those noted as complete above.</div><div>- Complete development of individual warfighter lightweight protective system technologies that will reduce body armor weight, improve survivability, and increase the mobility of the warfighter (concurrent funding provided by PE 0603640M).</div><div>- Complete development and transition transparent urban structures technologies which will enable tactical units to detect, classify and discriminate between friendly and enemy personnel in urban structures, and to gather ground data to dynamically develop 3D models to map urban areas using an Unmanned Air Vehicle (UAV)/Unmanned Ground Vehicle (UGV)-based system. (Concurrent funding provided by PE 0603640M.)</div><div>- Initiate development of technologies to lighten the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing Graphical User Interface (GUI)-based software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0603640M and PE 0603236N.)</div></div></div></div>					
LOGISTICS	3.268	4.786	5.559	0.000	5.559

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.</p> <p>FY 2009 funding reflects efforts in lightweight portable battlefield power sources supporting USMC priorities in lightening the load of the individual Marine and enhancing the Marine Corps rifle squad's overall capabilities; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs,</li><li>- Personal protection materials,</li><li>- Personal power generation,</li><li>- Micro power sources, and</li><li>- Augmented reality</li></ul> <p>The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Logistics activity are central to the integrated demonstration program.</p> <p>The FY 2009 to FY 2010 increase results from initiation of new applied research directed at producing a lightweight device for converting hydrocarbon fuels to electrical energy.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The FY 2010 to FY 2011 increase results from planned accelerated efforts to transition novel electrochemical capacitors required for meeting the peak power requirements of USMC squad level equipment.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued developing and assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore.</li><li>- Continued development of an alternate power source to reduce logistics footprint and increase sustainability of Marine expeditionary forces.</li><li>- Continued assessment of 20W Stirling Engine for increased efficiency during distributed operations.</li><li>- Continued assessment of portable, alternative water purification systems.</li><li>- Continued development of wireless vehicle health diagnosis and reporting.</li><li>- Continued development of advanced logistics distribution system.</li><li>- Completed analysis of Personal Power Network for transition to "Lighten the Load" FNC EC beginning in FY 2010.</li><li>- Initiated advancement of a solid oxide fuel cell capable of directly oxidizing liquid logistic fuels such as JP-8, thus eliminating the necessity for both reforming and sulfur removal pre-processing of the fuel.</li><li>- Initiated advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced lightweight portable power applications.</li><li>- Initiated applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Initiate applied research toward producing a light weight device for converting hydrocarbon fuels to electrical energy.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)								
				FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010. - Complete applied research in novel electrochemical capacitors for meeting the peak power requirements of USMC squad level equipment. (Relates to FY 2008 accomplishment of continued analysis of Personal Power Network/Centralized Distributed Operations Power Generation System.) - Complete applied research toward the direct oxidation of JP-8 fuel, without prior reforming or sulfur removal, in a solid oxide fuel cell. - Initiate applied research toward an extremely high specific energy metal-air primary battery.								
MANEUVER  The Maneuver thrust area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of the Marine Air-Ground Task Force (MAGTF). This thrust aims at capturing emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Special emphasis on survivability technologies for the defeat of small arms, IEDs, mine blast, and RPGs continue to be incorporated into this thrust area. Efforts also continue in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system's performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the program manager insight and guidance into pursuing future technologies. Finally, this technology thrust area also seeks to develop technologies to enhance combat vehicle crewman effectiveness and situational awareness through the incorporation of advanced autonomous vehicle functions triggered directly by the cognitive state of the operator. Beginning in FY 2009, Mine Counter Measure (MCM) efforts are funded under the Force Protection activity. Force Protection (FP) related technologies, including all MCM and counter Improvised Explosive Device (IED) related technology development are now reflected in that thrust area's submission.				5.722	6.269	7.139	0.000	7.139

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The increase in funding from FY 2009 to FY 2010 is due to initiation of technology programs to improve/increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover.						
The increase in funding from FY 2010 to FY 2011 is for initiation of programs to address and enhance maneuver capability gaps in mobility such as a vehicle stability effort to improve/increase vehicle performance characteristics including reducing vehicle rollover tendencies.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.</li><li>- Continued Cognitive Assessment and Task Management technologies for combat vehicle crewmen (formerly Augmented Cognition effort).</li><li>- Continued development of Advanced Electromagnetic Armor (E-NERA).</li><li>- Continued S&amp;T programs to address MAGTF Land MCM Master Plan capability gaps.</li><li>- Continued development of countermeasures for smart mine sensors.</li><li>- Continued mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs.</li><li>- Continued and completed development of materials to promote Combat Science and Technology Vehicle (CSTV) survivability.</li><li>- Continued development of advanced electromagnetic armor for ground vehicle survivability.</li><li>- Continued development of cognitive assessment and task management concept for CSTV.</li><li>- Continued integration of CSTV capabilities.</li><li>- Continued development of fuel efficiency and battlefield power technologies for the CSTV and ground vehicles.</li><li>- Completed development of scalable explosive neutralization methods.</li><li>- Initiated efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility in support of Distributed Operations.</li></ul>						

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C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0602114N: POWER PROJECTION APPLIED RESEARCH	0.000	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044
• 0603236N: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	0.000	2.042	2.141	0.000	2.141	0.000	0.000	0.000	0.000	0.000	4.183
• 0603640M: USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	15.523	15.244	16.030	0.000	16.030	13.142	10.742	6.778	0.000	0.000	77.459
D. Acquisition Strategy N/A											
E. Performance Metrics The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare and Combating Terrorism. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602131M: <i>Marine Corps Lndg Force Tech</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	6.482	6.473	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23.539
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: High Power Ultra Lightweight Zinc-Air Battery  <i>FY 2009 Accomplishments:</i> The Marine Corps has multiple Science and Technology Objectives (STOs) stating a need for the Warfighters to carry fewer batteries that are lighter, more powerful and longer lasting and has a power source capable of supporting all ground communications systems with increased mission run time per battery. This FY 2009 Congressional Add supported the STOs by developing an air electrode that provides 60% higher power capability over commercially available air electrodes.  <i>FY 2010 Plans:</i> This effort supports High Power Ultra Lightweight Zinc-Air Battery research.							2.493	1.992			
Congressional Add: Warfighter Rapid Awareness Processing Technologies  <i>FY 2009 Accomplishments:</i> This add supported Distributed Operations (DO). The USMC Distributed Operations concept posits the distribution of decision making authority across a wide number of junior leaders, who are directly engaged in							3.989	4.481			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602131M: <i>Marine Corps Lndg Force Tech</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<p>the fight. By moving authority "downward," the Marine Corps intends to dramatically increase the speed of command and action. In the tactical application of the DO concept, it is envisioned that maneuver units will operate in disaggregated fashion, with companies, platoons, and even squads dispersed beyond the normal range of mutually supporting organic direct fires, but linked through a common command and control network. This has tremendous implications across a broad front of S&amp;T efforts. The current focus of the add is on small-unit leader decision making and control of fires. The funding supported the exploration of all aspects of individual cognition and decision-making, physiology and ergonomics, and the technologies needed to integrate these aspects in order to support the development of a Marine who is optimized to perform within an asynchronous/ distributed operational setting.</p> <p><i>FY 2010 Plans:</i> This effort supports Warfighter Rapid Awareness Processing Technologies research.</p>		
Congressional Adds Subtotals	6.482	6.473
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602131M: <i>Marine Corps Lndg Force Tech</i>	PROJECT 9999: <i>Congressional Adds</i>
<u>E. Performance Metrics</u> Congressional adds.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602234N: Materials, Electr & Computer Tech							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	7.280	2.788	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.008
9999: Congressional Adds	7.280	2.788	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.008
A. Mission Description and Budget Item Justification This Program Element is funded in its entirety by two Congressional Adds.											
B. Program Change Summary (\$ in Millions)											
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total						
Previous President's Budget	7.280	0.000	0.000	0.000	0.000						
Current President's Budget	7.280	2.788	0.000	0.000	0.000						
Total Adjustments	0.000	2.788	0.000	0.000	0.000						
• Congressional General Reductions		-0.012									
• Congressional Directed Reductions		0.000									
• Congressional Rescissions	0.000	0.000									
• Congressional Adds		2.800									
• Congressional Directed Transfers		0.000									
• Reprogrammings	0.000	0.000									
• SBIR/STTR Transfer	0.000	0.000									
Congressional Add Details (\$ in Millions, and Includes General Reductions)										FY 2009	FY 2010
Project: 9999: Congressional Adds											
Congressional Add: Infrared Materials Laboratories										2.493	2.788
Congressional Add: Novel Coating Technologies for Military Equipment										4.787	0.000
Congressional Add Subtotals for Project: 9999										7.280	2.788
Congressional Add Totals for all Projects										7.280	2.788

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602234N: <i>Materials, Electr &amp; Computer Tech</i>	
<p><b><u>Change Summary Explanation</u></b></p> <p>Technical: Not applicable.</p> <p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy								DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602234N: Materials, Electr & Computer Tech				<b>PROJECT</b> 9999: Congressional Adds			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
9999: Congressional Adds	7.280	2.788	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.008
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							FY 2009	FY 2010			
Congressional Add: Infrared Materials Laboratories  <i>FY 2009 Accomplishments:</i> This effort supported the improvement of technology for long wavelength mercury cadmium telluride based infra-red focal plane arrays (FPAs).  <i>FY 2010 Plans:</i> This effort continues support of Infrared Materials Laboratory research.							2.493	2.788			
Congressional Add: Novel Coating Technologies for Military Equipment  <i>FY 2009 Accomplishments:</i> This effort supported further development of novel technologies that will enable deposition of coatings with extraordinary properties and that can be applied to airplanes, warships, tanks and other large military equipment on site and in open atmosphere, avoiding the current high costs in time and money of equipment disassembly and the use of vacuum chambers.							4.787	0.000			
Congressional Adds Subtotals							7.280	2.788			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602234N: <i>Materials, Electr &amp; Computer Tech</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<p><b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A</p> <p><b><u>D. Acquisition Strategy</u></b> N/A</p> <p><b><u>E. Performance Metrics</u></b> Congressional Interest Items not included in other Projects.</p>		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	89.673	90.440	70.168	0.000	70.168	67.281	63.400	62.980	66.380	Continuing	Continuing
0000: Common Picture Applied Research	81.196	82.732	70.168	0.000	70.168	67.281	63.400	62.980	66.380	Continuing	Continuing
9999: Congressional Adds	8.477	7.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	101.644
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&amp;T) Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>Activities and efforts in this program examine concepts and technologies that enable the transformation to network centric warfare. Network centric capabilities rely on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive network centric S&amp;T investments. The program focus is on S&amp;I and contains investments in the following Enabling Capabilities (ECs): Combat Identification (ID) Information Management of Coordinated Electronic Surveillance, Automated Control of Large Sensor Networks, OCO Focused Tactical Persistent Surveillance, Globally Netted Joint/Coalition Force Maritime Component Commander, Dynamic Tactical Communications Networks, Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC), High-bandwidth Free-space Lasercomm, Actionable Intelligence Enabled by Persistent Surveillance, Pro-Active Computer Network Defense and Information Assurance, Fast Magic, and NRL Space. In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance; Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		PE 0602235N: Common Picture Applied Research			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	85.209	83.163	0.000	0.000	0.000
Current President's Budget	89.673	90.440	70.168	0.000	70.168
Total Adjustments	4.464	7.277	70.168	0.000	70.168
• Congressional General Reductions		-0.377			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.086			
• Congressional Adds		7.740			
• Congressional Directed Transfers		0.000			
• Reprogrammings	5.722	0.000			
• SBIR/STTR Transfer	-1.258	0.000			
• Program Adjustments	0.000	0.000	70.168	0.000	70.168
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Cognitive Radio Institute				0.000	0.797
Congressional Add: Head Attitude Tracking System				0.000	1.593
Congressional Add: Intelligent Decision Exploration				0.000	3.884
Congressional Add: Sensor Integration Framework				1.197	1.434
Congressional Add: All Weather Sense & Avoid Sensors for UAVs				2.492	0.000
Congressional Add: Layered Surveillance/Sensing				1.596	0.000
Congressional Add: SOF Test Environment for Adv Team Collaboration Missions				1.995	0.000
Congressional Add: Unmanned Ground Vehicle (UGV) Mobility & Coordination in Joint Urban/Littoral En				1.197	0.000
Congressional Add Subtotals for Project: 9999				8.477	7.708
Congressional Add Totals for all Projects				8.477	7.708

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602235N: <i>Common Picture Applied Research</i>	
<p><b><u>Change Summary Explanation</u></b></p> <p>Technical: Not applicable.</p> <p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602235N: <i>Common Picture Applied Research</i>				<b>PROJECT</b> 0000: <i>Common Picture Applied Research</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Common Picture Applied Research</i>	81.196	82.732	70.168	0.000	70.168	67.281	63.400	62.980	66.380	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this program examine concepts and technologies that enable the transformation to network centric warfare. Network centric capabilities rely on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive network centric S&T investments. The program focus is on S&T and contains investments in the following Enabling Capabilities (ECs): Combat Identification (ID) Information Management of Coordinated Electronic Surveillance, Automated Control of Large Sensor Networks, OCO Focused Tactical Persistent Surveillance, Globally Netted Joint/Coalition Force Maritime Component Commander, Dynamic Tactical Communications Networks, Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC), High-bandwidth Free-space Lasercomm, Actionable Intelligence Enabled by Persistent Surveillance, Pro-Active Computer Network Defense and Information Assurance, Fast Magic, and NRL Space. In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance; Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
COMMUNICATION AND NETWORKS	10.161	6.721	8.811	0.000	8.811

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The overarching objective of this activity is to develop high throughput dynamic wireless communications and networks technologies critical to the mission performance and robustness of naval communications for widely dispersed mobile air, land, surface and submerged platforms. These platforms are often size, weight and power (SWaP) limited, and will operate under constraints of cluttered RF spectrum, harsh electro-magnetic interference (EMI) and Beyond Line Of Sight (BLOS) conditions. The technical payoff is increased network data rates, interoperability across heterogeneous radios, dynamic bandwidth management, and greater mobile network connectivity. The operational payoff is that warfighters from the operational command to the tactical edge have near real-time access to information, knowledge and decision-making necessary to perform their tasks, including coalition and allied forces. Emphasis is on tactical edge communications and networks to fully realize net-centric warfare, bridging the Global Information Grid (GIG) and the 'disadvantaged user', e.g., small-deck combatants, submarines, unmanned vehicles, distributed sensors and ground units in urban and radio frequency (RF) challenged environments. The current specific objectives are:</p> <p>a) Radios and Apertures: Develop technologies for high band radio, electrically-small and actively scanned antennas, addressing critical issue of radio spectrum bandwidth efficiency, spectrum contention and clutter, agile frequency communications with dynamic spectrum access, all-digital front-end with wide dynamic range, power amplifier efficiency, multipath effects, saltwater propagation and BLOS communications. Develop algorithms and signal processing for space-time-frequency diversity communications, including measures for electronic protection, such as low-intercept antijam waveforms and modulation. Develop affordable antenna technologies for small size and weight, high radiation efficiency, and wideband operation with rapid beam-steering. Develop alternatives to RF communications in airborne and terrestrial environments as well as high data rate underwater communications for undersea warfare (distributed sensors netting, unmanned underwater vehicle data exfiltration, submarine Communications at Speed and Depth) using electro-optic/infra-red (EO/IR) technologies. Develop secure, high bandwidth communications systems and the exploitation of existing</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and emerging network protocols that will avail development of new Low Earth Orbit (LEO) based data transport mechanisms.						
b) Tactical Networking and Network Control/Management: Develop advanced networking techniques for robust, highly dynamic environments; interoperable networks for secure communications and protocols, bandwidth and network management techniques that manage and allocate bandwidth across tactical and theater levels in support of net-centric operations. Develop rapidly auto-configuring and selforganizing networks with efficient and survivable routing, secure authentication, mobility management and Quality-of-Service guarantee while optimizing network resources. Address low bandwidth, synchronization and reliability for Service Oriented Architecture (SOA)/middleware architecture in both mobile ad-hoc networks (MANET) and infrastructure-based Internet Protocol (IP) backbone networks. Develop cognitive network planning and operations engines whose criteria are based directly on mission objectives while self-adapting and managing the spectrum allocation and radio resources in such a way that network operations, SOA community of interest, and computer network defense are integrated to form a single common tactical network picture that requires a minimum of human intervention and skill. Develop technology for improving tactical edge networking and for improving voice communications.						
The decrease from FY 2009 to FY 2010 is the result of the transfer of resources from this R2 Activity to the Knowledge Superiority and Assurance R2 Activity to support the Overseas Contingency Operations Focused Tactical Persistent Surveillance effort. Additionally, this was due to an increased level of effort on a one time basis during FY 2009 to investigate technology supporting networked electronic warfare efforts executing within this PE.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: Radios and Apertures: - Continued efforts to mature the superconducting cross-correlator to technology readiness level 4 to enable the development of a multi-function multi-net digital-Radio Frequency dehopping receiver for Link-16. This involves the integration of High Temperature Superconductors analog and Low Temperature Superconductors digital circuits in a COTS two-stage cryocooler. - Continued project to architect multi-Mega bits per second (Mbps) naval laser communication system for ships. Designed rate-adaptable optical receiver using avalanche photo-diodes and array-detection techniques for improved performance in poor weather conditions. - Continued Broadband Electronically-steerable Array for Mission Security (BEAMS), a low cost analog beam forming and steering technique for unmanned aerial vehicle (UAV) to UAV and UAV to ground station communications. - Continued development of an adaptive rate terminal to maintain laser communications in poor weather conditions. - Continued development of digital beam forming and steering for small UAVs in upper Ka band (38GHz), including Risley prism conformal antennas and lightweight switched beam antennas made of composite materials. - Continued development of submarine to unmanned underwater vehicle (UUV)/unmanned surface vehicle (USV)/sensor comms using underwater Modulating Retroreflector technology. - Continued development of low-cost integrated stub antenna and ferroelectric phased array technology for directional communications. - Continued the development of technical characteristics of a Communications Electronic Attack (EA) system that consists of a master EA platform that operates in concert with a network of simple subordinate platforms. - Continued development of underwater Extremely Low Frequency (ELF) antenna and RF technology for submarine comms at speed and depth.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of metamaterial structures and periodic inductive and capacitive loading for submarine High-Frequency Internet Protocol (HF-IP) buoy-cable antennas (BCA).</li><li>- Continue the development of pattern recognition algorithms to allow detection and identification of intruders into remote or urban areas.</li><li>- Completed prototyping of the conformal array for digital beam forming and steering on small UAVs in upper Ka band (38 GHz).</li><li>- Completed development of small foot-print, low-power fly-by optical communications underwater between UUVs/USVs and bottomed sensor field, utilizing direct modulated semiconductor lasers or modulating retro-reflectors (MRR)in the blue-green band.</li><li>- Completed prototyping of receivers that demonstrate ultra-wide band (UWB) range extension by time reversal methods.</li><li>- Completed the development of free space hybrid Infrared laser communications links with greater than 10X bandwidth of digital link for same power.</li><li>- Initiated development of Line of Sight (LOS) high data rate UAV-sensor communications for expeditionary forces.</li><li>- Initiated development of advanced signal processing, coding and switching amplifier techniques for high power amplification.</li><li>- Initiated metamaterials based dish antennas development for Ka-Ku band satellite communications (SATCOM).</li><li>- Initiated development of low intercept and low probability of Detection (LPD), jam resistant communications/networks for distributed nodes.</li><li>- Initiated blue-green fiber laser technology development for space-based submarine communications.</li></ul> <p>Tactical Networking and Network Control/Management:</p> <ul style="list-style-type: none"><li>- Continued development of Robust Airborne Networking Extensions (RANGE) for joint battlespace networking, networking UAVs, and hybrid mobile ad hoc networking (MANET)/satellite operation. Implemented MANET protocols for cross-layer optimized routing, including disruption tolerant networking to sensors and platforms.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: Radios and Apertures: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li><li>- Complete ultra wideband time reversal technique improvement, up to a factor of 2 compared to when channel estimation techniques are not used.</li><li>- Complete demonstrations of pattern recognition algorithms to allow detection and identification of intruders into remote or urban areas.</li><li>- Complete the development of technical characteristics of a Communications Electronic Attack (EA) system that consists of a master EA platform that operates in concert with a network of simple subordinate platforms.</li><li>- Complete the development wireless-ready, reliable data transport technologies suitable for tactical-edge and afloat networks.</li><li>- Initiate development and demonstrate electrically small antennas at VLF/HF, as well as lightweight beam steering antennas for UAVs using switched (ferrite) multi-horns and Risley prisms with 15-30 dB gain and 1.5 GHz bandwidth in the 38 GHz band.</li><li>- Initiate design and development of low observable jam resistant waveform, including directionalization, for advanced tactical data links.</li><li>- Initiate design and development of electronic protection for HF communications.</li></ul> Tactical Networking and Network Control/Management: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li><li>- Initiate development of a SOA-based secure tactical wide area network for coalition forces, showing independence of coalition tactical communications from satellite backhaul, bandwidth management and service discovery.</li><li>- Initiate development of topology control, discovery mechanisms and directional networking for free space optical links.</li><li>- Initiate design and development of cognitive netops for tactical communications.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Complete demonstrations of ELF/VLF switched antenna with higher radiation efficiency.</li><li>- Complete development of digital beam forming and steering for small UAVs in upper Ka band (38GHz), including Risley prism conformal antennas and lightweight switched beam antennas made of composite materials.</li><li>- Initiate development of structurally integrated HF antennas.</li><li>- Initiate development of integrated metamaterial antennas for ship and ground platforms.</li><li>- Initiate demonstrations of high peak power short pulse operation of fiber lasers in blue-green region.</li><li>- Initiate development of optical wavefront modulation techniques and optical phased array beam steering methods for terrestrial EO/IR Lasercomm.</li><li>- Initiate new architecture and modes of operation, develop prototypes for advanced tactical data link operation in both contested and anti-access regions.</li></ul> <p>Tactical Networking and Network Control/Management:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Initiate the development of social network analysis algorithms for protecting wireless networks.</li><li>- Initiate development of agent based communications, control and distributed authentication techniques in dynamic MANET networks.</li><li>- Initiate cognitive networking, cross-layer optimization protocols for light SOA for tactical networks</li></ul>					
COMPUTATIONAL FRAMEWORK AND METHODS FOR RAPID ACCURATE DECISION MAKING  The goal of this activity is to support FORCEnet by developing enablers for decision making and mission execution to achieve battlespace superiority. It focuses on the development of algorithms and software technologies that identify and integrate informational content from multiple sources, leading to decision aids that support user-cognitive processes. Because persistent sensors are generating massive amounts of data, the focus is on technologies that not only integrate information from diverse	26.373	24.785	15.516	0.000	15.516

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
sources, but also provide indications of information significance in ways that support the user's decision needs regardless of location and operational situation. To achieve this, it must be possible to automate understanding of the battlespace by identifying objects, determining relationships among the objects, assessing intent, and automatically generating courses of action with associated risks and uncertainty. Effort will also be devoted to developing technology for increasing assurance and security for C3 information systems and technology for improving information discovery and information presentation in such systems. The current specific objectives are:						
a) Automated Intelligence Tools: Develop automated image and signal intelligence understanding tools based on rigorous mathematical and statistical methods that lead to improved change detection, improve object and activity detection and recognition capabilities, context and scene understanding, and inferring of the threat levels to support decision making and persistent and adaptive surveillance.						
b) Battlespace Sensor and Intelligence Integration: Develop innovative methods for combining traditional and non-traditional data from sensors and disparate sources to provide the best estimate of objects, events, and conditions in the battlespace, in terms of their identity, associated error or uncertainty, context, impact, and infer relationships and their intentions.						
c) Automated Reasoning Methods and Models for Situational Analysis: Develop rigorous and efficient methods for building sophisticated situational models, develop automated reasoning techniques to categorize and recognize situations under a variety of conditions leading to methods that predict situations under different settings.						
d) Automated Decision Tools: Develop automated decision tools based on mathematically rigorous techniques (e.g., mathematical optimization) that support decision-making to ensure the best use of scarce and/or expensive resources to achieve optimal allocations for large complex scenarios, including ones that contain uncertainty, in drastically reduced amounts of time. Develop methods that support						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010				
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B. Accomplishments/Planned Program (\$ in Millions)								
				FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
decision making in networked sensor management and allocation to ensure sensor assets are deployed in an optimal or near optimal manner.								
e) Secure Sensor Networks: Develop tools and methods to securely handle information without exposing intelligence information about the networks or systems to adversaries.								
The decrease between FY 2009 and FY 2010 is the result of the transfer of resources from this R2 Activity to support the Globally Netted Joint/Coalition Force Maritime Component Commander and the Dynamic C2 for Tactical Forces and Maritime Operations Center areas in the Knowledge Superiority and Assurance Activity within this PE. The significant decrease between FY 2010 and FY 2011 is the result of the completion of activities and discontinuation of funding associated with the Joint Integrated Fires Control effort.								
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.								
FY 2009 Accomplishments: Automated Intelligence Tools: - Continued the demonstration and conducted image registration error analysis for the multi-resolution and multi-scale image processing effort. - Continued development of semi-supervised detection algorithms for multi-sensor imagery, video and human intelligence that will enable self-deploying sensor networks. - Continued development of interactive image/video-based surveillance systems for perimeter protection, and port protection. - Continued the development of a new radar signature analysis technique based on nonlinear dynamics.								

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued the development of a novel particle filter-based elevation angle tracking algorithm to improve the capability to track low-angle targets over the sea surface under multipath conditions using passive sensors.</li><li>- Continued the development of the theory and technology for near-field electromagnetic (EM) phenomenology relevant to high resolution, through-the-wall imaging at close ranges in urban operations.</li><li>- Completed development of automated methods for identifying significant changes between temporally separated images (not video) to extend work on automatic target recognition and pattern recognition into change detection algorithms.</li><li>- Completed efforts in automated image understanding that use active computations and visual pattern recognition for networked target recognition systems in maritime domain awareness.</li><li>- Completed development of a scalable system design for coordinated Unmanned Aerial Vehicle (UAV) formation control that integrates onboard and off-board sensor data.</li><li>- Complete the development of a new radar signature analysis technique based on nonlinear dynamics.</li><li>- Initiated development of coordinated multi-platform, multi-component waveforms.</li><li>- Initiated development of a real-time electronic warfare support deinterleaving capability.</li><li>- Initiated development of advanced communications emitter identification.</li></ul> <p>Battlespace Sensor and Intelligence Integration:</p> <ul style="list-style-type: none"><li>- Continued demonstration of a trusted data store which maintains data pedigree and detects anomalies in a limited objective experiment.</li><li>- Continued development of an interface between the Level 1 and Level 2/3 data fusion processes across federated service oriented architectures.</li><li>- Continued development of new data schemas and methods to allow more efficient assembly of a common operational picture (COP) integrating informational content from images, track data, intelligence and incomplete track data.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued Level 1 fusion algorithm and architecture design with associated ontology to manage information from automated sensors to provide a more dynamic and accurate battlespace picture through improved object refinement.</li><li>- Continued the development of software and algorithms for integrating the functions of target acquisition, tracking, data computation, and engagement control across multiple platforms for engaging multiple threats.</li><li>- Continued the investigation of service oriented methods to automatically retrieve relevant information for a community of interest.</li><li>- Continued the development and testing of the Joint Integrated Fires Control effort.</li><li>- Completed the development of a Case-Based Reasoning simulation/model for implementing situation, threat awareness fusion solutions and a Bayesian Network inference engine for manipulating uncertainty and learning from data.</li><li>- Completed efforts in Joint Director of Laboratory's Data Fusion Model Level 1/2/3 data fusion using abductive reasoning, Bayesian networks, agent-based techniques, statistical-based methods, and other approaches.</li><li>- Completed efforts in the automated integration of disparate sources of information that involve data mining methods and game theory.</li><li>- Completed development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems.</li><li>- Initiated approaches and tools for (semi)-automated data integration and reasoning about information from diverse sources in ways that support decision makers with timely, actionable information at operational and tactical levels of command, with an emphasis on missions that are related to OCO and force protection.</li></ul> <p>Automated Reasoning Methods and Models for Situational Analysis:</p> <ul style="list-style-type: none"><li>- Continued demonstration of predictive surface platform threat behavior algorithms and software employing techniques using pattern recognition on geospatial and attribute data. Also developed autonomous monitoring and reporting of high interest and anomalous maritime vessels.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of methods for automated generation of courses of action, including techniques for automated planning and reasoning in uncertain environments.</li><li>- Continued demonstration of anomaly detection, feature-based target tracking, track-to-pattern association and scoring, track-to-group clustering, pattern discovery and learning, pattern templates/ descriptions and predictive modeling tools in a limited objective experiment.</li><li>- Completed ontology-based information fusion for enhanced situational awareness and classification based knowledge discovery.</li></ul> <p>Automated Decision Tools:</p> <ul style="list-style-type: none"><li>- Continued the development of methods for selecting sensors and platforms for search and surveillance operations in a theater, allocating the selected sensors and platforms to specific missions, operating the allocated sensors during a mission, and fusing the information from the sensors and other sources.</li><li>- Completed sensor management algorithms that reduce the amount of labeled training data required, employing semi-supervised classifier and active learning techniques motivated by asymmetric threat, which limited training data anticipated.</li><li>- Initiated development of algorithms to optimize the selection from disparate and multiple information sources as well as the characterization of related pedigree over multiple user processing requests within extremely large data sets, including checks and balances between assignment, storage, search, quality, reliability, completeness, and latency.</li></ul> <p>Secure Sensor Networks:</p> <ul style="list-style-type: none"><li>- Continued development of technology to improve reliability of systems to survive Information Warfare attacks.</li><li>- Completed the development of a prototype for an information sharing infrastructure that maintains data integrity and confidentiality for enclaves of networked workstations running Commercial Off the Shelf (COTS) operating systems and applications.</li><li>- Completed development of technology for improved steganography and watermarking.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated development of improved separation technology for shared-hardware host execution environments to increase information security.</p> <p>Acquisition Workforce Fund:</p> <p>- Funded DoD Acquisition Workforce Fund.</p> <p><i>FY 2010 Plans:</i></p> <p>Automated Intelligence Tools:</p> <p>- Continue all efforts from FY 2009 less those noted as completed above.</p> <p>- Complete development of interactive image/video-based surveillance systems for perimeter protection, and port protection.</p> <p>- Initiate development techniques for image coding based on shapes and regions and their temporal evolution to facilitate image analysis as well as to enable efficient image transmission and restoration. Develop methods for efficient search of large image and video databases to facilitate automated, realtime image/video registration for surveillance applications, threat detection, and target geo-location.</p> <p>- Initiate development of mathematically rigorous techniques and algorithms for automated understanding of surveillance imagery, including background modeling to assist image context interpretation and multi-sensor characterization of complex scenes.</p> <p>Battlespace Sensor and Intelligence Integration:</p> <p>- Continue all efforts from FY 2009 less those noted as completed above.</p> <p>- Initiate development of tools and processes including higher level statistical methods, game theory, first order logic form, Bayesian networks, and fusion algorithms, to model enemy behavior and provide threat assessment, represent complex data patterns, and model the structure of context to improve the data fusion process.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate demonstrations of ontologies in a maritime environment using an experimental testbed or limited technology experiments to validate new approaches to inference and higher-level fusion capabilities.</li><li>- Initiate development of algorithms to generalize the characterization of ontologies and to integrate them, including machine processing compatibility to effectively link methods for visualization and human processing (UML methods) with machine and information exchange and processing (XML methods).</li></ul> <p>Automated Reasoning Methods and Models for Situational Analysis:</p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2009 less those noted as completed above.</li><li>- Initiate development of techniques to uncover trends, links, hidden models, and relationships of behavior/activity that will lead to inferring intent and developing course-of-action (COA) alternatives.</li><li>- Initiate development of robust reasoning methods supporting automated situational understanding for maritime domain awareness under time-critical constraints and uncertainty.</li><li>- Initiate development of methods of grouping situations to categorize algorithms for reuse under a variety of conditions, including Naval situation recognition and categorization (used to group similar situational types); situation characterization to define threshold qualifications to "bin" situations within categories (abductive development as a threshold process); situation projection to develop techniques to characterize features necessary to classify a situation - counterfactuals and inductive development.</li></ul> <p>Automated Decision Tools:</p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2009 less those noted as completed above.</li><li>- Complete the development of methods for selecting sensors and platforms for search and surveillance operations in a theater, allocating the selected sensors and platforms to specific missions, operating the allocated sensors during a mission, and fusing the information from the sensors and other sources.</li></ul> <p>Secure Sensor Networks:</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div><div>- Continue all efforts from FY 2009 less those noted as completed above.</div><div>- Initiate development of algorithms, secure protocols, architectures, software tools, languages, certification technologies, standards, guidelines to assure safe, secure, policy-compliant, interoperable systems for information transfer.</div></div> <div><div>FY 2011 Base Plans:</div><div>Automated Intelligence Tools:</div><div><div>- Continue all efforts from FY 2010 less those noted as completed above.</div><div>- Complete the demonstration and conducted image registration error analysis for the multi-resolution and multi-scale image processing effort.</div><div>- Complete development of semi-supervised detection algorithms for multi-sensor imagery, video and human intelligence that will enable self-deploying sensor networks.</div><div>- Complete development techniques for image coding based on shapes and regions and their temporal evolution to facilitate image analysis as well as to enable efficient image transmission and restoration. Develop methods for efficient search of large image and video databases to facilitate automated, realtime image/video registration for surveillance applications, threat detection, and target geo-location.</div><div>- Complete development of mathematically rigorous techniques and algorithms for automated understanding of surveillance imagery, including background modeling to assist image context interpretation and multi-sensor characterization of complex scenes.</div><div>- Initiate development of methods for integration of low-level image processing and high-level knowledge for simultaneous image segmentation and object recognition, and visual reasoning for image understanding.</div><div>- Initiate 3D image processing for object recognition and meaningful change detection.</div><div>- Initiate development of modular, interactive, intelligent video-based surveillance systems.</div></div></div> <div><div>Battlespace Sensor and Intelligence Integration:</div><div>- Continue all efforts from FY 2010.</div></div>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602235N: Common Picture Applied Research		PROJECT 0000: Common Picture Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete the development and testing of the Joint Integrated Fires Control effort.</li><li>- Complete demonstration of a trusted data store which maintains data pedigree and detects anomalies in a limited objective experiment.</li><li>- Complete development of an interface between the Level 1 and Level 2/3 data fusion processes across federated service oriented architectures.</li><li>- Complete development of new data schemas and methods to allow more efficient assembly of a common operational picture (COP) integrating informational content from images, track data, intelligence and incomplete track data.</li><li>- Complete Level 1 fusion algorithm and architecture design with associated ontology to manage information from automated sensors to provide a more dynamic and accurate battlespace picture through improved object refinement.</li><li>- Complete the development of software and algorithms for integrating the functions of target acquisition, tracking, data computation, and engagement control across multiple platforms for engaging multiple threats.</li><li>- Complete the investigation of service oriented methods to automatically retrieve relevant information for a community of interest.</li><li>- Complete approaches and tools for (semi)-automated data integration and reasoning about information from diverse sources in ways that support decision makers with timely, actionable information at operational and tactical levels of command, with an emphasis on missions that are related to OCO and force protection.</li><li>- Complete development of tools and processes including higher level statistical methods, game theory, first order logic form, Bayesian networks, and fusion algorithms, to model enemy behavior and provide threat assessment, represent complex data patterns, and model the structure of context to improve the data fusion process.</li><li>- Complete demonstrations of ontologies in a maritime environment using an experimental testbed or limited technology experiments to validate new approaches to inference and higher-level fusion capabilities.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete development of algorithms to generalize the characterization of ontologies and to integrate them, including machine processing compatibility to effectively link methods for visualization and human processing (UML methods) with machine and information exchange and processing (XML methods).</li><li>- Initiate development of algorithms and tools for information representation of unstructured data and structured data in a way that shared concepts/relationships in disparate data sets can be automatically compared, matched, or associated and in a way that can facilitate and improve information fusion.</li><li>- Initiate development of algorithms and tools for information fusion of heterogeneous data for classification and reconstruction based on high-level features inherent in each data source with the goal to form a more complete picture of battlespace environment.</li><li>- Initiate development of algorithms and tools for discovering and extracting higher-level features -- objects, events, patterns, intents, relations, anomalies -- from various data types in support of future asymmetric warfare.</li></ul> <p>Automated Reasoning Methods and Models for Situational Analysis:</p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2010.</li><li>- Complete demonstration of predictive surface platform threat behavior algorithms and software employing techniques using pattern recognition on geospatial and attribute data. Also developed autonomous monitoring and reporting of high interest and anomalous maritime vessels.</li><li>- Complete development of methods for automated generation of courses of action, including techniques for automated planning and reasoning in uncertain environments.</li><li>- Complete demonstration of anomaly detection, feature-based target tracking, track-to-pattern association and scoring, track-to-group clustering, pattern discovery and learning, pattern templates/ descriptions and predictive modeling tools in a limited objective experiment.</li><li>- Complete development of techniques to uncover trends, links, hidden models, and relationships of behavior/activity that will lead to inferring intent and developing course-of-action (COA) alternatives.</li><li>- Complete development of robust reasoning methods supporting automated situational understanding for maritime domain awareness under time-critical constraints and uncertainty.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Complete development of methods of grouping situations to categorize algorithms for reuse under a variety of conditions, including Naval situation recognition and categorization (used to group similar situational types); situation characterization to define threshold qualifications to "bin" situations within categories (abductive development as a threshold process); situation projection to develop techniques to characterize features necessary to classify a situation - counterfactuals and inductive development.</p> <p>Automated Decision Tools:</p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2010 less those noted as completed above.</li><li>- Complete the development of algorithms to optimize the selection from disparate and multiple information sources as well as the characterization of related pedigree over multiple user processing requests within extremely large data sets, including checks and balances between assignment, storage, search, quality, reliability, completeness, and latency.</li><li>- Initiate the development of optimization-based decision aids for resource allocation such as those required for mission planning at the strategic, operational, and tactical level.</li></ul> <p>Secure Sensor Networks:</p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2010.</li><li>- Complete development of technology to improve reliability of systems to survive Information Warfare attacks.</li><li>- Complete development of improved separation technology for shared-hardware host execution environments to increase information security.</li><li>- Complete development of algorithms, secure protocols, architectures, software tools, languages, certification technologies, standards, guidelines to assure safe, secure, policy-compliant, interoperable systems for information transfer.</li><li>- Initiate the development of anti-tamper methods that are capable of lengthy operation in unattended and un- powered environments, have very high probability of tamper detection and very low probability of false alarm, and remain undetected in the host system.</li></ul>					

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
HUMAN FACTORS AND ORGANIZATIONAL DESIGN	5.261	6.220	6.285	0.000	6.285
<p>The overarching objective of this activity is the achievement of FORCEnet and Sea Power 21 goals by developing human factors principles and cognitive models for human centric design, decision support systems for collaborative decision making, and adaptive command and control structures. The CNO's new Maritime Strategy and the Commander Fleet Forces Command complementary plan to revise organization of Maritime Operations Centers (MOC) place high priority on the aforementioned FORCEnet and Sea Power 21 goals. Specific objectives focus on improving small team, platform, task force, and battle group operations by developing advanced human factors technologies for incorporation into operational systems. The goals and payoffs are to enhance human performance effectiveness; improve the timeliness and quality of decision making; develop strategies to mitigate high workload and ambiguity; reduce manning; improve situational awareness and speed of command through a deeper understanding of human capabilities and limitations; and improvement of team decision making in ad-hoc, complex problem solving scenarios. The current specific objectives are:</p> <p>a) Human Computer Interaction/Visualization: Develop an understanding of the limitations of human perceptual and attentional systems in relation to maximizing user performance when interacting with complex Naval displays. A combination of computational cognitive modeling and psychological studies are employed to determine the capacity limitations on human performance that will undoubtedly have impact in reduced manning requirements, including information-rich weapons platforms. Develop technology for improving human interaction with autonomous systems and for improving virtual reality systems for training purposes.</p> <p>b) Collaboration and Knowledge Interoperability: Develop an understanding of the high-level cognitive processes underlying team knowledge processing, decision making and collaboration in order to improve team performance in the autonomous, agile, quick-response combat team of the future. Develop cognitive science-based tools, models, computational methods, and human-agent interfaces to enhance team collaboration effectiveness and team performance in complex problem solving</p>					

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teams. Specific objectives include application of discourse analysis methods and other process metrics to assess team performance. A conceptual model of team collaboration will be constructed and computational relationships among processes and team performance will be developed. Findings will be validated and demonstrated in operationally oriented testbeds by addressing issues including: rapid team analysis of large volume, uncertain data; knowledge interoperability in coalition ops; measures of team situational awareness; accelerated team synchronization; improved heterogeneous team performance; team collaboration performance metrics; cultural/language/experience-free representation and transfer of meaning.						
c) Organizational Design and Decision Support Systems: Develop quantitative executable models, task graphs and optimization algorithms for the organizational design of Maritime Operations Centers (MOC) consistent with the Navy's New Maritime Strategy. Investigate through modeling and simulation human competency requirements for staffing MOC. Develop quantitative formalisms for monitoring and assessing the completeness, consistency and accuracy of rules of engagement (ROE).						
d) Social Network Analysis: Develop computational models and algorithms for the analysis of terrorist threats and counter-measures and strategies against terrorist threats. Develop new computational algorithms for the discovery of missing and hidden nodes in complex graphs applicable to the problem of understanding hidden information in terror networks. Develop new approaches to calculation of network completeness. Develop computational approaches to the study of factionalism in social movements using Islamist movements as exemplar data collectivities.						
The increase from FY 2009 to FY 2010 reflects new program research to support MOC and additional social and cultural modeling.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: Human Computer Interaction/Visualization: - Continued application of cognitive architecture modeling to the design of interface analysis tools. - Continued research on the application of information architectures (DOD Architectures Framework), executable models (Petri Nets) and cognitive models to the systematic design of Human-Computer Integration. - Continued effort to develop tools for more automated, cost-efficient modeling of human system interaction. - Continued methods to introduce key cognitive abilities to autonomous vehicles that will enable warfighters and vehicles to work together more collaboratively.  Collaboration and Knowledge Interoperability: - Continued evaluation of Latent Semantic Analysis (LSA) of operator communications as an effective metric of shared situational awareness in unmanned aerial vehicle control teams. - Continued demonstration of Electronic Card Wall (EWALL) (a computational human cognitive processing system) for representation and transfer of meaning among heterogeneous and distributed team members engaged in complex problem solving. - Continued developing jointly with the Naval Air Systems Command, a FORCEnet-based test bed to identify and evaluate the cognitive processes to be employed to optimize collaborative decisionmaking in a geographically distributed and time-delayed situation. - Continued effort to improve response speed of the LSA tool to a near-interactive level and incorporate into a fleet experiment. Collected and evaluated data to validate improved speed and effectiveness of developing situational awareness. - Continued effort to incorporate the EWALL prototype into a simulation of the Tactical Operations Center of the Special Operations Forces and collected performance data to validate effectiveness.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued Sea Basing research on rehearsal for Expeditionary Strike Groups in the conduct of Maritime Interdiction Operations (MIO) and developed reach-back capability for computationally intense analysis for evaluating courses of action.</li><li>- Continued development of metrics to identify and measure the contribution to team performance of the cognitive processes underlying ad-hoc team decision making.</li><li>- Continued effort to improve the model of ad-hoc team decision making by including collaborative agent-based contribution to team performance.</li><li>- Initiated development of a computational model of subjective reasoning for course of action selection activity in distributed, asynchronous teams.</li><li>- Initiated test and validation of a cognitive processes model of team collaboration in a Maritime Interdiction Operations domain.</li><li>- Initiated integration of high-level planning and computational cognition with low-level to enhance situational awareness via swarm-based sensor platforms.</li></ul> <p>Organizational Design and Decision Support Systems:</p> <ul style="list-style-type: none"><li>- Continued model-based simulations and experiments to investigate the effectiveness of hierarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts.</li><li>- Continued deployment of models for Effects-Based Operations (EBO) aboard naval vessels to support Expeditionary Group One to conduct kinetic and non-kinetic tactical operations in a measured manner.</li><li>- Continued jointly with the Air Force applied research on the integration of Information Operations in Air Control Centers.</li><li>- Continued applied research on command and control adaptive architectures for Expeditionary Strike Groups working with OPNAV and Expeditionary Strike Group ONE, San Diego.</li><li>- Continued research on adaptive command and control architectures in support of the Navy's new Maritime Strategy.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated research on quantitative formalisms for developing and assessing the completeness, consistency and accuracy of rules of engagement (ROEs).</li><li>- Initiated research on executable models and optimization algorithms for adaptive command structures that are congruent with mission requirements to support the design of Maritime Headquarters with Maritime Operations Centers (MHQ/MOC) organizations.</li><li>- Initiated research on models to support the design of scalable joint and coalition Maritime Operations Centers that allocate responsibilities to elements afloat and ashore.</li></ul> <p>Social Network Analysis:</p> <ul style="list-style-type: none"><li>- Continued development of new threat scenarios incorporating Joint Force Maritime Component Commander operations, counter-insurgency and humanitarian operations with the staff of the Naval War College. These new threat scenarios will provide the basis for Limited Objective Experiments in the Innovation Laboratory at the Naval War College.</li><li>- Continued development of Dynamic Network analysis (a terrorist network analysis tool) in operational command setting at U.S. Pacific Command.</li><li>- Continued the improvement of terror network analysis decision tools for combatant command use and military planning, including testing of tools, development of metrics, and validation.</li><li>- Continued the development of advanced computational models capable of analyzing multidimensional networks of thousands of nodes. Current capabilities enable the analysis of networks consisting of hundred of nodes.</li><li>- Continued the development of computational models of influence that incorporate the social structure, values and cultural processes of urban non-western communities for achieving post-conflict stabilization.</li><li>- Continued the development of social network models to model the human element in maritime domain awareness.</li><li>- Continued research on advanced computational models to incorporate additional capabilities in the analysis of terror networks and on various types of flow in these networks (such as the flow of expertise, resources).</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div><div>- Continued effort to improve social network models to analyze merchant marine traffic.</div><div>- Initiate human cultural and social modeling to improve warfighting, civilian military operations and humanitarian operations in non-Western environments.</div></div> <div>FY 2010 Plans:</div> <div>Human Computer Interaction/Visualization:</div> <div><div>- Continue all efforts of FY 2009.</div><div>- Initiate development of a testbed for validating cognitive models of operator performance in crossmodal (audio/visual) task environments.</div></div> <div>Collaboration and Knowledge Interoperability:</div> <div><div>- Continue all efforts of FY 2009.</div><div>- Initiate research on the use of metaphors and temporal mental models to improve representation and transfer of meaning in ad-hoc, complex team problem solving with the objective of enhancing team collaboration effectiveness and team performance.</div><div>- Initiate validation of a conceptual model of macrocognition in teams. Scenario-based experimentation will define the presence, persistence and relevance of individual and team cognitive processes and relationships among those processes. Deliverable will be a computational understanding of how teams collaborate to reach consensus.</div></div> <div>Organizational Design and Decision Support Systems:</div> <div><div>- Continue all efforts of FY 2009.</div><div>- Initiate, in cooperation with the Air Force, the capability to examine human competency requirement in offensive and defensive cyber operations and the effects of courses of action at the tactical and operational level. The research would be conducted using DOD and academic laboratories capable of high fidelity mission simulation and precise measurements of independent and dependent measures.</div></div> <div>Social Network Analysis:</div>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continue all efforts of FY 2009.</p> <p><i>FY 2011 Base Plans:</i> Human Computer Interaction/Visualization:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate the development of the multitasking and metacognitive components of the Tactical Action Officer (TAO) model, especially as they apply to dual-tasks involving "chat" style instant-messaging interleaved with other watchstanding duties.</li><li>- Initiate the development of spatialized 3D-audio displays to mitigate cognitive load during the performance of dual-tasks.</li><li>- Initiate the investigation of human attentional limitations in understanding sped-up and serialized speech over multiple radio channels.</li><li>- Initiate the development of cognitive-model-based predictors of operator error in procedural tasks.</li><li>- Initiate the development of cognitive models of the TAO to be utilized within a virtual Combat Information Center (CIC) simulated environment.</li><li>- Initiate the investigation of auditory attentional effects on watchstanding activities, especially in the context of monitoring multiple radio channels. Results will be used to provide recommendations for new communications protocols.</li></ul> <p>Collaboration and Knowledge Interoperability:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate development of a performance measurement testbed for assessing the contribution of highlevel cognitive (macrocognitive) processes to collaboration effectiveness and team performance in special operations intelligence analysis.</li><li>- Initiate validation of computational team collaboration performance metrics for quick response teams such as maritime interdiction operations and non-combatant evacuation operations.</li></ul> <p>Organizational Design and Decision Support Systems:</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate cooperative development with the Air Force of a series of networked laboratories for hybrid human-agent experimentation on multi-echelon decision making and adaptive architectures for large maritime operations centers.</li><li>- Initiate investigations on Battlespace on Demand Decision Making: Operational Application of Meteorological and Oceanographic Data in Command Decision Making.</li></ul> <p>Social Network Analysis:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>						
KNOWLEDGE SUPERIORITY AND ASSURANCE		21.745	25.546	34.334	0.000	34.334
<p>This activity is devoted to midterm technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated program of record.</p> <p>The Future Naval Enabling Capabilities in this activity span across the Information Infrastructure, Applications/Tools/Decision Aids, Command and Control, Apertures and Radios, Tactical Networks and Network Control/Management, and Computer Network Defense and Information Assurance technology areas. Technologies being developed will integrate sensors, networks, decision aids, weapons and supporting systems into a highly adaptive, human-centric, comprehensive maritime system. This system will operate from the sea bed to space in a Service Oriented Architecture that can be used in a Joint Environment. The current specific objectives are:</p> <p>a) Combat ID Information Management of Coordinated Electronic Surveillance - Develop software algorithms and techniques for the purpose of dynamically re-tasking organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include developed capability for automated integration of multi-intelligence surveillance &amp; reconnaissance of</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems.						
b) Automated Control of Large Sensor Networks - Develop smart tactical sensors/platforms and software algorithms for automated and mission specific tactical sensor fields capable of fulfilling specific mission objectives with smart sensors that forward knowledge vice raw data.						
c) OCO Focused Tactical Persistent Surveillance - Develop agile and enhance tactical sensors for a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to other contingency operations to include organic sensors for small tactical expeditionary units, capable of supporting the dynamic character of modern operations from the highly mobile to the long-term.						
d) Globally Netted Joint/Coalition Force Maritime Component Commander - Develop automated tools and software to capture and share information for 'globally-networked, theater-focused' maritime capabilities that will enhance Joint Task Force (JTF) and COCOMs' ability to execute their intentions.						
e) Dynamic Tactical Communications Networks - Develop dynamically adaptive automated software algorithms, protocols, and network management techniques that provide a self-organizing networking capability. This capability will adapt to available links of opportunity at lower echelons and assure priority movement of critical data intra-network and through reachback gateway networks that interface with the Global Information Grid (GIG).						
f) Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC) - Develop software for command control and combat systems that will provide the maritime commander agile and responsive control and management of tactical Antisubmarine Warfare (ASW) and interactions in a net centric						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
enterprise environment. Focus will address classified ASW requirements for command and control at the tactical level.						
g) High-bandwidth Free-space Lasercomm - Develop, integrate and demonstrate free-space optical terminals and retro-reflector optics that are designed to provide an affordable, reliable and highbandwidth Free-Space Laser Communications (Lasercomm) capability which is adaptive and agile in mitigating a wide range of atmospheric and maritime turbulence, precipitation and obscuration conditions. This capability will enable surface and airborne platforms to exchange very high bandwidth information in Navy Tactical Networks, even with limited SATCOM or RF spectrum access.						
h) Actionable Intelligence Enabled by Persistent Surveillance - Develop analysis tools and software that will provide accurate threat detection by exposing the enemy's vulnerabilities, unmasking their latent networks, discovering their tactics, techniques, procedures and exploiting in new ways the vast amount of sensor data available today against an irregular threat. Also develop the following: An electrooptical, infrared and laser Intelligence, Surveillance, and Reconnaissance Targeting (ISRT) optics technology, capable of wide Field of View/Field of Range (FOV/FOR) at variable resolution & pointing direction, for installation in mobile platforms without gimbals; a light weight, low cost sensor suite and autonomy algorithms to enable detection and avoidance of all classes of aircraft or Unmanned Aerial Vehicles (UAV).						
i) Pro-Active Computer Network Defense and Information Assurance - Develop algorithms, protocols, and software that will allow the warfighter to 1)identify and counter real-time threats to the network during mission execution, 2) provide dynamic security management and component management of networked-based assets to support mission execution, and 3) ensure mission essential capabilities and data exist despite malicious cyber actions.						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
j) Fast Magic - Develop algorithms and computer and information technologies for Naval forces to respond quickly against multiple threats. Details are classified.					
k) NRL Space - Develop vessel tracking fusion algorithms and software to integrate multiple modalities of informational elements including literal and non-literal information. Develop algorithms and techniques for handling incorrect, out of sequence and intermittent sensor data to provide persistent situational awareness.					
The increase from FY 2009 to FY 2010 is due to the initiation of new FNC efforts to develop tools and software that will increase the commander's ability to predict threats and support weapons allocation.					
The increase from FY 2010 to FY 2011 is due to the initiation of new FNC Enabling Capability efforts Pro-Active Computer Network Defense and Information Assurance, Fast Magic, and NRL Space.					
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.					
FY 2009 Accomplishments: Combat ID Information Management of Coordinated Electronic Surveillance: - Continued the Electronic Warfare Integrated System for Small Platforms (EWISSP) effort by exploration and refinement of the subsystem interface software that will operate via Versa Module Eurocard (VME)-64 and Recommend Standard (RS)-422 buses. - Continued Actionable Information from Multiple Intel Sources in a Global Information Grid Enterprise Services (GIG-ES) Environment. Provides automated integration of multi-INT surveillance and reconnaissance of red, white, and blue force locations for Combat ID by providing software integrated into Navy and Marine Corps Command Control & Combat Systems; order of magnitude less false recognition; and identification of significant military entities consistent with sensor capabilities.					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued developing and testing airborne and shipboard battle manager platforms for UAVs operating from Littoral Combat Ships. Continued developing and began testing an open architecture airborne control station that can be used onboard a P-3 type aircraft for the control of multiple UAVs.</p> <p>- Continued the all-source track and identity fusion effort integrating a broad range of intelligence product information including: Kinematic Radar Reports, Organic and UAV imagery, electronic and communications emissions and human spot reports for tactical and organic sensors to be augmented with national sensors.</p> <p>Automated Control of Large Sensor Networks:</p> <p>- Continued design of tools enabling mission-specific tactical sensor fields for at least two separate mission areas.</p> <p>- Continued design of tactical distributed data analysis and automated indications and warnings for 50% of tactical data.</p> <p>- Continued design of automated tactical platform and sensor planning and management sufficient for one operator to control multiple sensors.</p> <p>- Continued investigation of human to tactical sensor field interface to enable the user to locate relevant knowledge within 3 minutes.</p> <p>- Continued development of automated and mission aware large tactical sensor management engines and irregular threat and tactical sensor ontologies.</p> <p>- Continued development of the agents and other analysis applications enabling a fully netted tactical battlespace.</p> <p>Globally Netted Joint/Coalition Force Maritime Component Commander:</p> <p>- Initiated effort to develop and apply emerging technologies that support delivery of Navy-approved FNC enabling capabilities structured to close operational capability gaps that involve the common picture.</p> <p>- Initiated packaging of emerging common picture technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated efforts for the mature common picture technologies that support naval requirements identified within the FORCEnet naval capability pillar.</p> <p>Dynamic Tactical Communications Networks:</p> <p>- Initiated effort to develop and apply emerging technologies that support self organizing networking and assured communications exchange in tactical communications networks.</p> <p>Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC):</p> <p>- Initiated effort to develop new, and leverage emerging, technologies that support dynamic and response management and control of net-centric enterprise theater and tactical ASW operations. This includes automation support for synchronized planning of resources and multi-mission execution, and access and shared awareness of data activities and status among Maritime Operation Centers and tactical forces in a tactical, netted service-oriented architecture (SOA) environment.</p> <p><i>FY 2010 Plans:</i></p> <p>Combat ID Information Management of Coordinated Electronic Surveillance:</p> <p>- Continue all efforts of FY 2009.</p> <p>- Initiate demonstrations of the adaptation of fusion and resource management capabilities directly into Distributed Information Operations-Service (DIO-S).</p> <p>Automated Control of Large Sensor Networks:</p> <p>- Continue all efforts of FY 2009.</p> <p>- Initiate demonstrations of mission-aware planning tools that allow large sensor networks to support tactical operations.</p> <p>OCO Focused Tactical Persistent Surveillance:</p> <p>- Initiate development of high information tactical agile sensors, including tactical RF sensors, sensors to sense the state of a person and smart tactical imagers and acoustic sensors.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2009. - Initiate development of fusion algorithms and methods that support building and maintaining large distributed databases; implementing GIG-compliant data strategies; mediating and integrating across heterogeneous databases; accessing and discovering authenticated users and brokering agents; and identifying ambiguities or inconsistencies for additional sensing and processing.						
Dynamic Tactical Communications Networks: - Continue all efforts of FY 2009. - Initiate development of distributed-and dynamic policy based network management, secure mobility management solutions, and network service discovery mechanisms. - Initiate development of robust and bandwidth efficient group communication protocols for the tactical environment, including disruption tolerance and inter-domain (security and routing) protocols for fullyconnected domains.						
Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Continue all efforts of FY 2009. - Initiate development of tools and algorithms that support automated data access, shared awareness, and automated synchronized planning, coordination and execution of network enterprise resources among tactical units with limited/degraded communications.						
High-bandwidth Free-space Lasercomm: - Initiate development of mitigation techniques for laser beam propagation through atmospheric turbulence and aerosol obscuration. - Initiate development of and demonstrate technologies that support high bandwidth laser communications, including fast acquisition and fine beam steering/tracking algorithms; wide-area avalanche photo-diode receive array techniques; and high bandwidth wide field-of-view retro-reflector						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
optics.  Actionable Intelligence Enabled by Persistent Surveillance: - Initiate development of advanced analysis tools that are relevant to the information needs of tactical warfighters engaged against irregular actors. - Initiate development of a multi-modal tactical wide area surveillance payload and sensors relevant to tier-2 UAVs that can detect other airborne platforms.  FY 2011 Base Plans: Combat ID Information Management of Coordinated Electronic Surveillance: - Continue all efforts of FY 2010.  Automated Control of Large Sensor Networks: - Continue all efforts of FY 2010. - Complete development of automated and mission aware large tactical sensor management engines and irregular threat and tactical sensor ontologies. - Complete development of the agents and other analysis applications enabling a fully netted tactical battlespace.  OCO Focused Tactical Persistent Surveillance: - Continue all efforts of FY 2010.  Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2010. - Initiate demonstration of the dynamic distributed data layer, role-relevant representation and visualization, and adaptive collaboration assistant in a series of Limited Technology Experiments and Limited Technology Objectives to verify the ability to provide information flow in real time across theaters.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Dynamic Tactical Communications Networks: - Continue all efforts of FY 2010. - Continue development of, and initiate demonstration of, distributed-and dynamic policy based network management and secure mobility management solutions, network service discovery mechanisms, and robust and bandwidth efficient group communication protocols for the tactical environment, including disruption tolerance.						
Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Continue all efforts of FY 2010. - Initiate development of automated capabilities for generating multiple alternative course of action (COA) recommendations to the commander including automated development of force plans and allocation of related resources (e.g. sensors, platforms, weapons) and processes; and dynamic management and re-planning of tactical force goals, activities and resources.						
High-bandwidth Free-space Lasercomm: - Continue all efforts of FY 2010. - Initiate development of and demonstrate error correction methods and adaptive optics techniques for turbulence mitigation; and ultra-fast pulsing for obscuration.						
Actionable Intelligence Enabled by Persistent Surveillance: - Continue all efforts of FY 2010.						
Pro-Active Computer Network Defense and Information Assurance: - Initiate development of Next Generation Sensors and Gateways to provide security and control mechanisms to protect networks, data and systems from attacks (e.g., malicious code, data exfiltration).						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Completed development of a robust test environment to elucidate the design principles of human and sensor network interactions.</p> <p><i>FY 2010 Plans:</i></p> <p>- Continue all efforts of FY 2009 less those noted as completed above.</p> <p>- Complete effort to improve the resolution of the High Frequency Relocatable Over-the-Horizon Radar (HF-ROTHR) more than two orders of magnitude using time-reversal methods.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Complete improvements in the resolution of the High Frequency Relocatable Over-the-Horizon Radar (HF-ROTHR) more than two orders of magnitude using time-reversal methods.</p>					
<p>TACTICAL SPACE EXPLOITATION</p> <p>The Tactical Space Exploitation initiative explores the application of new space craft technologies on small, light-weight and low-cost satellites to enhance naval warfighting capabilities; taking advantage of the global access, revisit and connectivity provided by orbital platforms.</p> <p>Initial efforts will be aimed at developing integrated signals electronics packages to test new concepts for global ship tracking and two-way data exfiltration using next-generation Internet Protocol (IP) technology from an array of sea-based and land-based sensors. Advanced multispectral/ hyperspectral electro-optical sensors will be developed to demonstrate new warfighting constructs and communications payload technology deployed on satellites to demonstrate augmented mobile satcom capabilities over a theater. Affordably expendable payload and bus technologies will be developed, which will serve as building blocks for future responsive space systems: payloads, bus technologies and significant space robotic technologies that address on-orbit inspection, servicing, repair and assembly, and mission-life extension.</p>	16.694	18.373	4.132	0.000	4.132

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The decrease between FY 2010 and FY 2011 is the result of investments in this activity being curtailed in response to completion of the efforts associated with the Comm-X payload development and launch aboard TACSAT 4 satellite.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
FY 2009 Accomplishments:						
- Continued development of integration plans, algorithms, and satellite concept of operations to demonstrate integrated signals payload.						
- Continued development of small multifunctional integrated signals electronics systems for ship tracking from space and two-way data exfiltration from distributed global sensors.						
- Continued program to use chemical release from satellites launched into selected low-Earth orbits to de-populate intense trapped electrons in radiation belts following a low-altitude nuclear explosion in space.						
- Continued the development of a highly capable self-inspection vehicle for spacecraft with large complex deployables.						
- Continued the development of a preliminary design for electrodynamic propulsion technology demonstration spacecraft.						
- Completed and launched maritime hyperspectral payload on TacSat or Space Test Program (STP) satellite. Develop improved maritime hyperspectral payload for flight on the International Space Station through STP. Complete analysis of TacSat 3 data.						
- Initiated effort to develop technologies using autonomous bi-dexterous manipulation for closeproximity operations in space.						
FY 2010 Plans:						
- Continue all efforts of FY 2009 less those noted as completed above.						
- Complete Comm-X payload and launch it aboard TACSAT 4 satellite.						

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<ul style="list-style-type: none"> <li>- Complete the development of a highly capable self-inspection vehicle for spacecraft with large complex deployables.</li> <li>- Complete the development of a preliminary design for electrodynamic propulsion technology demonstration spacecraft.</li> </ul> <p><i>FY 2011 Base Plans:</i> Base FY 2011 Plans:</p> <ul style="list-style-type: none"> <li>- Continue all efforts of FY 2010 less that noted as completed above.</li> <li>- Complete the development of a preliminary design for electrodynamic propulsion technology demonstration spacecraft.</li> </ul>											
Accomplishments/Planned Programs Subtotals						81.196	82.732	70.168	0.000	70.168	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0603235N: <i>COMMON PICTURE ADVANCED TECHNOLOGY</i>	31.136	42.477	44.878	0.000	44.878	49.742	34.581	28.932	12.769	0.000	244.515
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> This PE supports the development of technologies that enable the transformation to network centric warfare. Net-centric operations include communications and information assurance capabilities to enable all-source data access, tailored dissemination of information to Command and Control (C2) and Intelligence, Surveillance and Reconnaissance (ISR) users across the network, and rapid, accurate decision making based on this information. The operational benefits sought are increased speed of response, accuracy, and precision of command; distributed self-synchronization; flexibility and adaptability to an operational situation; and decision superiority.  Specific examples of metrics under this PE include:											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602235N: <i>Common Picture Applied Research</i>	<b>PROJECT</b> 0000: <i>Common Picture Applied Research</i>
<ul style="list-style-type: none"> <li>- Increase network data rates and interoperability across heterogeneous radios; improve dynamic bandwidth management and mobile network connectivity.</li> <li>- Increase the understanding of the battlespace by the development of automated tools for extracting information from images and signals, identifying objects, determining relationships among the objects, assessing intent, and generating courses of action.</li> <li>- Improve human-factors design principles resulting in enhanced human performance effectiveness, improved timeliness and quality of decision making, reduced manning, and improved team decision making in ad-hoc, complex problem solving scenarios.</li> <li>- Improve the integration of sensors, networks, decision aids, weapons, and supporting systems into a highly adaptive, human-centric, comprehensive maritime system.</li> <li>- Improve integrated signals electronics packages small, light-weight, and low-cost satellites to test new concepts for global ship tracking and two-way data exfiltration.</li> </ul>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602235N: <i>Common Picture Applied Research</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	8.477	7.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	101.644
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Cognitive Radio Institute <i>FY 2010 Plans:</i> This effort supports Cognitive Radio Institute research.							0.000	0.797			
Congressional Add: Head Attitude Tracking System <i>FY 2010 Plans:</i> This effort supports Head Attitude Tracking System research.							0.000	1.593			
Congressional Add: Intelligent Decision Exploration <i>FY 2010 Plans:</i> This effort supports Intelligent Decision Exploration research.							0.000	3.884			
Congressional Add: Sensor Integration Framework							1.197	1.434			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602235N: <i>Common Picture Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported research into an improved common operating picture for the warfighters.		
<i>FY 2010 Plans:</i> Continue this effort to support Sensor Integration Framework research.		
Congressional Add: All Weather Sense & Avoid Sensors for UAVs  <i>FY 2009 Accomplishments:</i> This effort supported the design, fabrication and testing of a comprehensive all weather sense and avoid system. The system will provide a sensing, decision making and maneuver commands to enable safe separation of aircraft and UAVs.	2.492	0.000
Congressional Add: Layered Surveillance/Sensing  <i>FY 2009 Accomplishments:</i> This effort supported the development of a layered network of real-time fire control quality data together with on demand situational awareness information distributed across near real-time subnets.	1.596	0.000
Congressional Add: SOF Test Environment for Adv Team Collaboration Missions  <i>FY 2009 Accomplishments:</i> This effort supported technological advancements within the common operational picture and real time team collaboration - key technology elements of the SOF TEAMS efforts.	1.995	0.000
Congressional Add: Unmanned Ground Vehicle (UGV) Mobility & Coordination in Joint Urban/Littoral En	1.197	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602235N: <i>Common Picture Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development and demonstration of technologies for unmanned ground vehicles (legged robots) with the advanced mobility necessary for negotiating urban terrain to enhance the capabilities of the U.S. Armed Forces and reduce risk for troops.		
Congressional Adds Subtotals	8.477	7.708
<b>C. Other Program Funding Summary (\$ in Millions)</b>		
N/A		
<b>D. Acquisition Strategy</b>		
N/A		
<b>E. Performance Metrics</b>		
Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	114.262	118.783	113.724	0.000	113.724	97.518	92.886	92.352	92.861	Continuing	Continuing
0000: Warfighter Sustainment Applied Res	92.082	103.726	113.724	0.000	113.724	97.518	92.886	92.352	92.861	Continuing	Continuing
9999: Congressional Adds	22.180	15.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	135.425
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This PE supports the Future Naval Capabilities (FNCs) of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, Seabasing and Enterprise and Platform Enablers (EPE) FNC; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; naval systems training; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and seabasing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	115.700	104.169	0.000	0.000	0.000
Current President's Budget	114.262	118.783	113.724	0.000	113.724
Total Adjustments	-1.438	14.614	113.724	0.000	113.724
• Congressional General Reductions		-0.495			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.011			
• Congressional Adds		15.120			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.597	0.000			
• SBIR/STTR Transfer	-2.035	0.000			
• Program Adjustments	0.000	0.000	113.724	0.000	113.724
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Managing and Extending DOD Asset Lifecycles (Medal)					
Congressional Add: Nanotechnology for Anti-Reverse Engineering					
Congressional Add: Productization of Anti-Fouling and Fouling Release Coating Systems					
Congressional Add: Acoustic Research Detachment Test Support Platform Upgrade					
Congressional Add: Advanced Composite Maritime Manufacturing					
Congressional Add: Assistive Technologies for Injured Servicemembers					
Congressional Add: Biosensors for Defense Applications					
Congressional Add: Composite Materials Enhancements through Polymer Science Research and Development					
Congressional Add: Digital Directed Manufacturing Project					
Congressional Add: Intelligent Retrieval of Imagery					
Congressional Add: Friction Stir Welding					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: <i>Warfighter Sustainment Applied Res</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Nanotechnology Engineering &amp; Manufacturing Operation (NEMO)</i>		1.596	0.000
Congressional Add: <i>On-Board Vehicle Power Systems Development</i>		2.393	0.000
Congressional Add: <i>Optimization of New Marine Coatings</i>		1.596	0.000
Congressional Add: <i>PULSE Virtual Clinical Learning Lab</i>		2.393	0.000
Congressional Add Subtotals for Project: 9999		22.180	15.057
Congressional Add Totals for all Projects		22.180	15.057
<b><u>Change Summary Explanation</u></b>			
Technical: Not applicable.			
Schedule: Not applicable.			
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: <i>Warfighter Sustainment Applied Res</i>				<b>PROJECT</b> 0000: <i>Warfighter Sustainment Applied Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Warfighter Sustainment Applied Res</i>	92.082	103.726	113.724	0.000	113.724	97.518	92.886	92.352	92.861	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This PE supports the FNC's of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, Enterprise and Platform Enablers (EPE) FNC; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; Naval systems training and education; human systems integration; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and Sea Basing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>ADVANCED NAVAL MATERIALS</b>	12.788	15.515	23.876	0.000	23.876
Advanced Naval Materials efforts include: developing advanced, high-performance materials; processes to reduce weight and cost; and enhanced sonar transducers.					
The increase between FY 2010 to FY 2011 is due to energy initiative.					
<i>FY 2009 Accomplishments:</i>					
- Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.					
- Continued development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res				
B. Accomplishments/Planned Program (\$ in Millions)								
				FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of advanced composites and polymers with fire resistance for ship structures.</li><li>- Continued development of nanotube reinforced composite materials for next generation air and naval platforms.</li><li>- Continued development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials and definition of standardized materials properties and composition ranges.</li><li>- Continued development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications.</li><li>- Continued development of cavitation resistant ship rudder coatings based on the FY 2004 shipboard coating study.</li><li>- Continued marine titanium alloy design and processing development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications.</li><li>- Continued development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms.</li><li>- Continued stainless steel carburization study to enhance corrosion performance.</li><li>- Continued development of surface preparation methods and characterization of corrosion performance for future naval ship materials.</li><li>- Continued evaluation of low temperature carburized materials for marine application.</li><li>- Continued development of coating performance and knowledge database for Naval use.</li><li>- Continued development of mechanistic model for stress corrosion cracking in Nickel Aluminum Bronze (NAB).</li><li>- Continued friction stir welding development for control of residual stresses and elimination of distortion in naval steels.</li><li>- Continued development of innovative sonar transducers based on high-strain, high-coupling piezoelectric single crystals.</li><li>- Continued development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.</li></ul>								

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements.</li><li>- Continued development of materials processing methods for single crystal piezoelectrics to make strong, robust sonar transducers.</li><li>- Continued modeling and process development of single-melt cold hearth casting of naval titanium alloys including Ti 5-1-1-1 for enhanced mechanical properties and formability.</li><li>- Continued development of models and characterization methods for dynamic loading (water slamming and blast loading) in polymer composite materials.</li><li>- Continued ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties.</li><li>- Continued acoustic damping coatings for ship tank application.</li><li>- Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. (Transitioned from Cost Reduction Technologies Activity in FY 2009).</li><li>- Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. (Transitioned from Cost Reduction Technologies Activity in FY 2009).</li><li>- Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. (Transitions from Cost Reduction Technologies Activity in FY 2009).</li><li>- Completed development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications.</li><li>- Continued development of new 3D mechanical characterization technique for polymer composites based on dissipative energy density principles.</li><li>- Continued development of continuous based monitoring techniques of new synthetic fuels and lubricants based on electromagnetic signature analysis.</li><li>- Continued development and application of distributed fiber optic Bragg gratings for structural health</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>monitoring of ships and aircrafts.</p> <ul style="list-style-type: none"><li>- Initiated development of novel growth methods to specialized single crystal transducer materials tuned to requirements of specialized naval systems.</li><li>- Initiated assessment of the degree of sensitization potential of marine grade Al alloys.</li><li>- Initiated investigation of criteria for stable pitting of stainless steel.</li><li>- Initiated development of surface assessment technologies to measure surface profile and chlorine.</li><li>- Initiated evaluation of advanced material coating for erosion control on helicopter main rotor blade leading edges.</li></ul> <p>The following efforts transition from Cost Reduction Technologies in this PE in FY 2009:</p> <ul style="list-style-type: none"><li>- Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials.</li><li>- Continued development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties.</li><li>- Initiate development of seamless joining technologies for large, complex shaped conventional ceramic windows from small, inexpensive components using electrophoretic deposition of ceramic nanoparticles.</li><li>- Initiate development of intelligent corrosion sensor systems for intergranular corrosion cracking.</li><li>- Initiate studies on fuel cell corrosion.</li><li>- Initiate development of superhydrophobic surface modification technology.</li><li>- Initiate studies on mitigation of pitting corrosion and stress corrosion cracking in marine aluminum alloys.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Initiate development of quantitative coating quality assurance tools. - Initiate development of surface tolerant coating removal methods. - Initiate development of processing technologies to fabricate piezoelectric single crystals into complex transducer assemblies. - Initiate development of thermal management system(s) to arrest excessive heat fluxes and loads on amphibious ship by advanced Naval/USMC aircraft. - Initiate development of MEMS based sensor nodes, with energy harvesting and wireless communication capabilities, for system health management and prognosis.					
BIOCENTRIC TECHNOLOGIES  Biocentric technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. Topic areas include, but are not limited to development of biologically-based signal processing for medical, surveillance and security applications; bioinspired robotics; microbial or plant engineering to produce high-value naval materials such as energetic compounds or to develop sentinel organisms, and marine mammal diagnostics to support the Navy's Fleet Marine Mammal Systems.  FY 2009 Accomplishments: - Continued engineered microbial synthesis and processing of energetic materials. - Continued development of innovative naval biosensors, biomaterials, and bioprocess technology (i.e., engineered plants for explosives detection, study of human stress biomarkers and bioinspired panoramic imaging systems). - Continued efforts on naval biosensor to detect brain structures and blood vessels through skull bones. - Continued, developed and demonstrated methods for determining multiple microbial genetic	6.346	5.636	5.800	0.000	5.800

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms. - Continued a program to develop a microfabricated analytical system for trace detection of illicit materials including explosives, and other hazardous chemicals. - Continued efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on animal wing and fin biomechanics. - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks. - Continued effort to power AUV recharging station using (sediment) microbial fuel cell. - Continued effort to develop single domain antibodies for the recognition of explosives and small toxins. - Continued marine mammal immunomarker efforts, including the characterization of the dolphin fore-stomach microbial community, identification of probiotic immunostimulating species and immunobioassays for stress and infection detection. - Completed biomimetic temporal pattern recognition for security breaching noise detection and biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing. - Completed development of an initial set of molecular diagnostic tests for bacterial, fungal and viral pathogens of marine mammals. - Completed program to aid warfighter protection that will provide versatile systems for tagging and tracking using chemical tangents tailored to simultaneously satisfy operational requirements and match optical or physio-chemical detection. enable effective collaboration of warfighters and autonomous systems. - Initiated development of underwater chemical sensors powered by sediment fuel cell. - Initiated research for detection or mitigation of microbes or compounds of naval relevance in various settings. - Initiated integration of biomimetic sonar with bioinspired autonomous undersea vehicles (with high-lift propulsors) to achieve closed loop control.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated effort to develop living fluidic networks.</p> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete research on microbial synthesis of phloroglucinol, an energetic material precursor.</li><li>- Complete effort to develop and demonstrate methods for determining multiple microbial genetic sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms.</li><li>- Complete development of a microfabricated analytical system for trace detection of illicit materials including explosives, and other hazardous chemicals.</li><li>- Initiate development of a second set of molecular diagnostic tests for recently discovered viral, bacterial, and fungal pathogens of marine mammals.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Initiate long duration, realistic field tests of autonomous microbial fuel cell power systems for underwater sensor networks.</li><li>- Initiate efforts for bio-inspired massively parallel vision systems.</li></ul>						
COST REDUCTION TECHNOLOGIES		9.278	8.854	11.620	0.000	11.620
Cost Reduction Technology efforts include: developing ultrareliable materials and sensors to reduce cost by enabling condition-based and zero maintenance capabilities; and airframe and ship corrosion efforts for advanced cost effective prevention and life cycle management technologies. This activity includes the Navy's share of the Versatile, Affordable, Advanced Turbine Engine (VAATE) program for materials. Investments under this activity were previously reported under Advanced Naval Materials and were broken out to provide improved clarification of the overall investment scope. The decrease from FY 2009 through FY 2010 is due to FNC EPE-FY10-03 being pushed out and an Accounting Management Reduction. The increase from FY 2010 to FY 2011 is to support FNC EPE-FY10-03.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued development of ceramic matrix composite turbine blades for gas turbine engines.</li><li>- Continued development of cavitation resistant ship rudder coatings.</li><li>- Continued development of durable alloys and materials for shipboard and aircraft gas turbine engines and spallation-resistant thermal barrier coatings for shipboard/aircraft marine gas turbine hot sections.</li><li>- Continued development of advanced materials and processes for high temperature marine turbine disks and combustors.</li><li>- Continued development of oxidation and vanadium/sulfate-resistant high temperature coatings for shipboard/aircraft gas turbine engines.</li><li>- Continued development of calcium magnesium aluminum-silicate (CMAS)-resistant coatings for ceramic matrix composites.</li><li>- Continued development of high temperature foil bearing coatings for aircraft engine weight reduction.</li><li>- Continued development of high temperature organic matrix composites.</li><li>- Continued development of low-platinum and platinum-free aluminide coatings that are phase compatible with turbine blade alloys and exhibit low oxidation rates.</li><li>- Continued efforts to assess manufacturing issues and reliability of ceramic matrix composites for turbine engines.</li><li>- Continued integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section.</li><li>- Continued development of materials processing for future gas turbine molybdenum-based alloys.</li><li>- Continued efforts to conduct warfighter sustainment applied research, including technology management of investments supporting the naval enterprise and naval capability pillars.</li><li>- Continued efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps.</li><li>- Continued efforts to assess technology options for the development of applied FNC technologies packaged into deliverable science and technology products.</li><li>- Continued applied research and development of improved coatings for (1) non-skid surfaces, (2) ship</li></ul>						

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		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>rudders, (3) high performance ship topsides, and (4) high performance airfield pavements.</p> <ul style="list-style-type: none"><li>- Continued analytical model and reduced scale component development of shipboard compact power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers, focusing on closing technology gaps associated with Alternative Integrated Power System Architectures. (This effort transferred to PE 0602123N in FY 2009).</li><li>- Initiated applied research in determining lifting of hot section materials exposed to alternative synthetic fuels and petroleum-synthetic fuel blends.</li><li>- Initiated applied research development of Calcium Magnesium Aluminum-Silicate (CMAS)-resistant coatings for molybdenum-base alloys.</li><li>- Initiated life prediction research for modeling of hot section gas turbine materials, including blades, in mixed naval environments.</li><li>- Initiated development of an Adaptive Expert System to automatically and rapidly analyze aircrew performance (1M+ flight hours annually) to detect human factors related mishap leading indicators using a new technique with anomaly detection and corroboration.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2009.</li><li>- Complete integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section.</li><li>- Initiate durable environmental barrier coatings for 2700F ceramic-matrix composites.</li><li>- Initiate research on Nb-Cr-Si alloys for improved corrosion resistance at high temperatures.</li><li>- Initiate, develop and apply emerging technologies that support delivery of Navy approved FNC enabling capabilities structured to close operational capability gaps in warfighter sustainment.</li><li>- Initiate package emerging warfighter sustainment technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period.</li><li>- Initiate and develop mature warfighter sustainment technologies that support naval requirements identified within the Naval Power 21 capability pillars.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate development of novel seawater pretreatment strategies to optimize performance of prefiltration membranes (microfiltration or ultrafiltration membranes or filters).</li><li>- Initiate further development of novel high flux and chlorine resistant reverse osmosis membranes.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Complete development of high temperature foil bearing coatings for aircraft engine weight reduction.</li><li>- Complete integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section.</li><li>- Initiate research and development of ceramic matrix composite vanes for Naval aircraft.</li><li>- Initiate applied research on radiation barrier coatings.</li><li>- Initiate development of 1500F capable disk coatings.</li><li>- Initiate development of advanced ASGS (Active Shaft Grounding System) with integrated shaft current sensing and extremely low frequency electromagnetic (ELFE) control.</li><li>- Initiate development of novel ICCP (Impressed Current Cathodic Protection) anodes, reference cells and sensors with high Mean Time Between Failure(MTBF).</li><li>- Initiate development of dual-use ICCP and novel sensor technology for CBM and closed-loop deamping to extend hull/ballast coating longevity and reduce recalibration frequency.</li><li>- Initiate applied research in modeling and simulation to identify key corrosion drivers and target problem areas for material modification and improved barrier dielectrics.</li><li>- Intitiate development of spatial corrosion recognition and diagnostic models for hull, ballast tanks and propulsor condition.</li></ul>						
ENVIRONMENTAL QUALITY		2.995	3.116	3.139	0.000	3.139
Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements, and support the Navy Transformational Roadmap in the areas of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued development of new, advanced, environmentally benign AF/Anti-Corrosive (AC) coating systems for Navy platforms, far-term noise and air pollution emissions abatement technology for unrestricted operations, and multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). - Continued initial development of robotic Hull Biomimetic Underwater Grooming (BUG) and associated grooming approaches. - Continued development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Continued pilot scale system development of miniature gasification process for treatment of shipboard solid waste. - Continued and completed initial decision report on impact of synthetic lubricants on shipboard oily waste treatment systems. - Continued development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants. - Completed development of the Mobile Cleaning Recovery and Recycling System (MCRRS) vehicle for cleaning of aircraft non-skid decks as a part of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Completed initial development of robotic Hull BUG and associated grooming approaches. - Initiated field evaluation of prototype robotic Hull BUG to identify gaps needed to refine and advance the technology.						
FY 2010 Plans: - Continue all efforts of FY 2009 less those noted as completed above. - Complete pilot scale system development of miniature gasification process for treatment of shipboard solid waste.						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete far-term noise and air pollution emissions abatement technology for unrestricted operations.</li><li>- Complete multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP).</li><li>- Initiate efforts on ballast tank and system design optimization that minimize fuel discharges from compensated systems, minimize sedimentation in clean ballast and compensated ballast tanks, and maximize exchange of organisms during ballast tank exchanges.</li><li>- Initiate efforts on solids separation/removal from shipboard liquid waste streams.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Complete field evaluation of prototype robotic Hull BUG and transition to FNC program.</li><li>- Complete development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants.</li><li>- Initiate efforts on improved handheld, waterborne, underwater hull cleaning technologies.</li><li>- Initiate studies on oil emulsion issues on existing and new ships.</li></ul>					
HUMAN SYSTEMS DESIGN	3.357	2.171	3.197	0.000	3.197
<p>This activity supports the warfighter by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention.</p> <p>Congressional, DoD, and Navy policies and instructions require the Navy and Marine Corps to have a comprehensive plan for Human Systems Design (HSD) in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the systems.</p>					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued research to develop automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning. - Continued research to develop tactical decision making concepts to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making. - Continued HSD tool research, development, and application to engineering efforts to develop robust standardized set of human systems integrated specific modeling and simulation tools to assess the interaction between operators performance by system design by manning levels.						
FY 2010 Plans: - Continue all efforts of FY 2009. - Initiate research into mission performance optimization encompassing task centered design and advanced human performance modeling for achieving the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet. - Initiate research into enhancing the ability to identify and fuse relevant multi-sensor data and then effectively presenting this information to the decision making team in order to gain tactical knowledge and improve their operational performances.						
FY 2011 Base Plans: - Continue all efforts of FY 2010. - Complete research to develop automation and human interface technologies to support decisionmaking in which multiple system operators manage groups of with optimal manning. - Complete research to develop tactical decision making concepts to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making.						

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B. Accomplishments/Planned Program (\$ in Millions)						
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- Initiate research into incorporating environmental stressors impact (fatigue, motion, vibration and extreme temperatures) into systems engineering tool for the development of complex systems.						
LITTORAL COMBAT / POWER PROJECTION  This activity provides for technologies that enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the Littorals. The FNC Program considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; strike; maneuver; sustainment; and fleet/force protection. This activity includes technical assessments and trade studies for FNC Enabling Capabilities that transition high priority technologies to the Navy and Marine Corps in support of the Sea Strike, Sea Shield, Sea Basing, and ForceNet Naval Power 21 pillars as well as Enterprise and Platform Enabling Science and Technology requirements.  The increase from FY 2009 to FY 2010 is due to the initiation of new FNC efforts to reduce the load of dismounted combatants and to improve SSN/SSGN next generation photonics mast capabilities. The decrease from FY2010 to FY 2011 is due to the realignment of FNC efforts to other PE's.  FY 2009 Accomplishments: - Continued efforts to conduct FNC warfighter sustainment applied research, including technology management of FNC investments supporting the naval enterprise and naval capability pillars. - Continued efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps. - Continued efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products.  FY 2010 Plans: - Continue all efforts of FY 2009. - Initiate development of technologies to reduce the load of warfighters by 1) reducing the weight		6.015	13.333	11.593	0.000	11.593

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing GUI-based software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0603236N) - Initiate research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification. (Concurrent funding provided by PE 0603236N) - Initiate efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products.  FY 2011 Base Plans: - Continue all efforts of FY 2010. - Realign development of technologies to reduce the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing GUI-based software for tradeoff analyses bases on Military Operational Posture to PEs 0602131M, 0603236N and 0603640M.						
MANPOWER/PERSONNEL  These technologies enhance the Navy's ability to select, assign, and manage its people by responding to a variety of requirements, including: managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems while managing individual workload and supporting optimal manning.  This activity further supports the warfighter by providing enhanced capabilities by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention.		2.735	2.737	2.391	0.000	2.391

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued development of a virtual, experimental-based software environment to test and evaluate the effect of various incentive structures on resource allocation decision making.</li><li>- Continued development of artificial intelligence and optimization techniques to create simulation based decision support tools for resource allocations across units and battle groups.</li><li>- Continued development of Unit-level tools to enable commanders to analyze the cost implications of their actions and weigh tradeoffs between readiness, cost, and risk.</li><li>- Continued development of intelligent agents to empower total force members to make training and assignment choices that enhance their careers and meet personal goals.</li><li>- Continued research to provide results for guiding the development on an interface allowing experts in HSI to work with subject matter experts to define and refine critical intra-domain concepts while capturing information for future use.</li><li>- Continued a continuous engineering process evaluation and adaptation to show that the developing process is executable and effective.</li><li>- Completed low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>					
MEDICAL TECHNOLOGIES	9.595	18.329	18.092	0.000	18.092
This program supports the development of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs					

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are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not applied research related to development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee, and Joint Technical Coordinating Group (JTTCG) process, to prevent duplication of effort. This project funds the Force Health Protection FNC that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".						
The increase from FY 2009 to FY 2010 reflects the initiation of Naval Noise-Induced Hearing Loss (NIHL) efforts to reduce the incidence of NIHL.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued program to develop enhanced First Responder capabilities.</li><li>- Continued program to develop enhanced Forward Resuscitative Surgical capabilities.</li><li>- Continued program to develop enhanced En Route Care capabilities.</li><li>- Continued efforts to mitigate the effects of environmental and other threats to health.</li><li>- Continued program, with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)).</li><li>- Continued efforts to reduce operational injuries.</li><li>- Continued efforts to reverse NIHL.</li><li>- Continued studies on decompression sickness (DCS) and arterial gas embolism (AGE), to include novel approaches to the prevention, detection and treatment of DCS/AGE, particularly by nonrecompressive methods.</li><li>- Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes.</li></ul>						

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<div><div>- Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance. Underwater thermal extremes can affect diver performance and alter risk of incurring decompression sickness.</div><div>- Continued studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors.</div><div>- Continued studies related to optimization of submariner health and performance. Submarine crewmembers are exposed to a variety of unique stressors including prolonged deployments, effects of altered diurnal rhythms, non-standard breathing gases, lack of sunlight, etc that can impact health and performance.</div><div>- Continued studies related to biomedical effects of underwater sound. Military divers must operate safely and effectively in potentially complex underwater sound fields.</div><div>- Continued efforts for "stress inoculation" to mitigate the impact of exposure to stressful combat environments prior to deployment.</div></div> <div><div>FY 2010 Plans:</div><div>- Continue all efforts of FY 2009.</div><div>- Continue efforts to develop advanced technologies to support Rapid Blood Treatment. (Previously identified as First Responder in FY09 in this activity)</div><div>- Continue efforts to develop advanced technologies to support Warfighter Restoration. (previously identified as FRSS/ERSS in FY09 in this activity).</div><div>- Continue efforts to develop advanced technologies to support Warfighter Restoration. (Previously identified as En Route Care in FY09 in this activity).</div><div>- Continue efforts to model accelerated head and neck injuries; operational injuries.</div><div>- Completed safety studies and analysis of compartmental shipboard heat exposure levels; environmental threats to health.</div><div>- Initiate research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction.</div><div>- Initiate research to study the incidence and susceptibility of Noise Induced Hearing Loss (NIHL) and tinnitus, and to evaluate mitigation strategies.</div></div>						

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<ul style="list-style-type: none"><li>- Initiate research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears).</li><li>- Initiate research to improve personal protective equipment technology.</li><li>- Initiate research to develop a Human Injury and Treatment (HIT) model for predicting outcomes of personnel exposure to shipboard damage.</li><li>- Initiate and develop mature force health protection technologies that support naval requirements identified within the Navy and Marine Corps.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate program in hypothermics.</li><li>- Initiate development of multifunctional blood substitute program.</li></ul>					
SEA BASING TECHNOLOGIES	27.560	23.577	24.127	0.000	24.127
<p>This activity includes development and advancement of technologies to support Seabasing. Areas include: advanced hull forms, propulsion, and materials to support high speed, shallow draft, and beachable connectors; innovative connector interface and transfer technologies; advanced wave and position sensors and autonomous controls to support vessel to vessel interfaces; and autonomous conveyance systems to support automated and integrated warehousing.</p> <p>The decrease in funding from FY 2009 to FY 2010 is due to the beginning of technical evaluation and down-selection for the T-CRAFT as well as the beginning of prototype and component development for the T-CRAFT.</p> <p>FY 2009 Accomplishments:</p> <ul style="list-style-type: none"><li>- Continued planning of T-CRAFT prototype and component development.</li><li>- Continued Sense and Respond Logistics (S&amp;RL) research in: battlefield fuel management; decision support systems for S&amp;RL; emergent intelligence/intelligent agents for S&amp;RL; and advanced sensors/ processes for S&amp;RL.</li></ul>					

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<ul style="list-style-type: none"><li>- Continued efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. (Transitions from Cost Reduction Technologies activity in this PE in FY 2009.)</li><li>- Continued multiple INP contracts for preliminary designs in the area of a T-CRAFT and a Rapidly Deployable Seabasing Stable Transfer Platform.</li><li>- Continued the down-selection of T-CRAFT designs for further development and model construction and testing.</li><li>- Continued T-CRAFT model construction and testing.</li><li>- Continued the construction of a scaled model of a Rapidly Deployable Stable Transfer Platform demonstrator.</li><li>- Continued a second evaluation of potential Seabasing INP efforts.</li><li>- Initiated the down-selection of Sense and Respond Logistics Information Architecture prototype development.</li></ul> <p>Acquisition Workforce Fund:</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete the down-selection of T-CRAFT designs for prototype and component development.</li><li>- Complete T-CRAFT model testing and evaluation.</li><li>- Initiate contract design and develop shipyard building plans for T-CRAFT prototype and component construction.</li><li>- Initiate procurement of components and material to support T-CRAFT prototype construction.</li><li>- Initiate development of agent based decision support and logistics planning algorithms.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Complete T-CRAFT contract design and shipyard building plans.</li></ul>						

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<ul style="list-style-type: none"><li>- Initiate development of a detailed T-CRAFT prototype test and demonstration plan.</li><li>- Initiate T-CRAFT and component construction.</li><li>- Initiate the modeling and simulation of first article prototypes of Sense and Respond demonstration systems; Logistics Common Operating Picture, Decision Support Tools, Prognostics Embedded Health Management, Maco Fuel Quantity Management, Portable Fuel Quality Analysis.</li><li>- Initiate development of the Connectors and the Sea Base Enabling Capability including Environmental Ship Motion Forecasting and Advanced Mooring System Technologies.</li></ul>					
TRAINING TECHNOLOGIES  Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, while deployed, and to operate effectively in the complex, highstress, information-rich and ambiguous environments of modern warfare such as asymmetric warfare. Technology development responds to a variety of requirements, including providing more affordable approaches to training and skill maintenance. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the development, delivery, evaluation, and execution of training.  FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued development of optimized strategies for performance aiding and training.</li><li>- Continued development of virtual technologies for warfare training application.</li><li>- Continued development of technologies to support human performance in networked warfighting environments.</li><li>- Continued development of training technologies for culture, values, and language training and opponent simulation for training systems.- Continued program on intelligent agents for objective-based training.</li><li>- Continued Computer Generated Forces (CGF) task aimed at improved techniques for human cognitive and behavioral modeling.</li></ul>	11.413	10.458	9.889	0.000	9.889

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res		PROJECT 0000: Warfighter Sustainment Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks.</li><li>- Continued a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.</li><li>- Continued work on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring.</li><li>- Continued task to apply recently developed learning techniques that can be used in a model interacting with its application environment to extend or refine its knowledge base and behavioral competence.</li><li>- Continued task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates.</li><li>- Continued field studies and user tests evaluating new features and job aiding tools.</li><li>- Initiated research to create computational models of human behavior in selected non-Western environments that reflect the dominant cultural, social, ethnic, and economic determinants of behaviors, attitudes, and beliefs of individuals, groups, and organizations operating in these environments, and exploit these models to forecast responses to our actions and those of others attempting to exert influence in these environments.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Initiate research into computational neuron-models in the design of training systems</li><li>- Initiate the integration of cognitive and neuron-computational models of human learning.</li><li>- Initiate research into intelligent tutoring systems for adaptive competency in submarine bridge team and surface ship combat information center trainers.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602236N: Warfighter Sustainment Applied Res				PROJECT 0000: Warfighter Sustainment Applied Res			
B. Accomplishments/Planned Program (\$ in Millions)											
						FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
- Complete development of optimized strategies for performance aiding and training - Complete development of virtual technologies for warfare training application. - Initiate research to identify the perceptual cues in the urban and dense infrastructure and environment that may improve warfighter performance.											
Accomplishments/Planned Programs Subtotals						92.082	103.726	113.724	0.000	113.724	
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0603236N: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	38.414	50.625	56.311	0.000	56.311	63.410	43.106	35.585	17.278	0.000	304.729
• 0603729N: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	8.603	12.463	12.471	0.000	12.471	13.580	12.359	5.083	2.493	0.000	67.052
D. Acquisition Strategy											
Not applicable.											
E. Performance Metrics											
As discussed in Section A, there are a significant number of varied efforts within this PE. For the most part these efforts support the FNC program. As such, each is monitored at two levels. At the lowest level each is measured against both technical and financial milestones on a monthly basis. Annually each FNC and its projects are reviewed in depth for technical and transition performance by the Chief of Naval Research against goals which have been approved by the Navy.											
The FNC managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or biannual review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy								DATE: February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: Warfighter Sustainment Applied Res				<b>PROJECT</b> 9999: Congressional Adds			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: Congressional Adds	22.180	15.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	135.425
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Managing and Extending DOD Asset Lifecycles (Medal)							0.000	1.593			
FY 2010 Plans: This effort supports Managing and Extending DOD Asset Lifecycles (MEDAL) research.											
Congressional Add: Nanotechnology for Anti-Reverse Engineering							0.000	2.390			
FY 2010 Plans: This effort supports Nanotechnology for Anti-Reverse Engineering research.											
Congressional Add: Productization of Anti-Fouling and Fouling Release Coating Systems							0.000	2.788			
FY 2010 Plans: This effort supports Productization of Anti-Fouling and Fouling Release Coating Systems research.											
Congressional Add: Acoustic Research Detachment Test Support Platform Upgrade							1.496	0.000			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: <i>Warfighter Sustainment Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the exploration of the assembly of the Acoustic Research Detachment Test Support Platform Upgrade - the development of a modern test support platform configured with modern systems, acoustically isolated generators, and an effective laboratory space.		
Congressional Add: Advanced Composite Maritime Manufacturing  <i>FY 2009 Accomplishments:</i> This effort supported research into the ability of the Navy to build advanced ships more economically and to build ships that will be more capable, have a longer service life, and be less costly to maintain.  <i>FY 2010 Plans:</i> Continued efforts to support Advanced Composite Maritime Manufacturing research.	1.995	1.593
Congressional Add: Assistive Technologies for Injured Servicemembers  <i>FY 2009 Accomplishments:</i> This effort supported research into the development and deployment of novel, non-invasive methods of sensory augmentation and replacement to permit wounded service-members who suffer from sensory loss to regain some level of basic sensation that will allow them to interact with others and with the environment around them.  <i>FY 2010 Plans:</i> Continued efforts to support Assistive Technologies for Injured Servicemembers research.	1.596	0.797
Congressional Add: Biosensors for Defense Applications	1.994	0.797

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: <i>Warfighter Sustainment Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<p><i>FY 2009 Accomplishments:</i> This effort supported research into the potential of a novel, Navy-developed lead-free nanomaterial munitions primer (or other anthropogenic pollutants such as quantum dots) and the possibilities of unintended environmental, cellular and organism-level effects.</p> <p><i>FY 2010 Plans:</i> Continued efforts to support Biosensors for Defense Applications research.</p>		
<p>Congressional Add: Composite Materials Enhancements through Polymer Science Research and Development</p> <p><i>FY 2009 Accomplishments:</i> This effort supported research and development of composite materials in the area of composite matrix and technology for lighter weight, stronger, stiffer, higher toughness, more accurate property predictions, and accurate service life prediction through fundamental and applied research and development. The three primary areas are matrix materials and matrix characterization, specialty materials for matrix protection and healing, and fiber modification and characterization.</p> <p><i>FY 2010 Plans:</i> Continued efforts to support Composite Materials Enhancements Through Polymer Science Research.</p>	2.235	5.099
<p>Congressional Add: Digital Directed Manufacturing Project</p> <p><i>FY 2009 Accomplishments:</i> This effort supported the enhancement of the Digital Direct Manufacturing technology for manufacturing net shape metal and polymeric parts by characterizing the properties of parts made of thermoplastics and metals, developing models to achieve dimensional control, exploring new</p>	1.695	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: <i>Warfighter Sustainment Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
design opportunities and develop design rules, and exploring new materials such as high temperature thermoplastics and Naval metals and alloys.		
Congressional Add: Intelligent Retrieval of Imagery  <i>FY 2009 Accomplishments:</i> This effort supported the protection of harbors and Naval facilities from asymmetric warfare threats by researching the development of intelligent imagery retrieval.	2.393	0.000
Congressional Add: Friction Stir Welding  <i>FY 2009 Accomplishments:</i> This effort supported the demonstration of the feasibility of expanding Friction Stir Welding (FSW) technology beyond aluminum alloys to High Strength Low Alloy (HSLA) steels that are of interest to the Navy and to expand the fundamental understanding of the FSW process to other metals.	0.798	0.000
Congressional Add: Nanotechnology Engineering & Manufacturing Operation (NEMO)  <i>FY 2009 Accomplishments:</i> This effort supported the development of anti-corrosive, flame retardant interior coatings for military application using nano-technology.	1.596	0.000
Congressional Add: On-Board Vehicle Power Systems Development  <i>FY 2009 Accomplishments:</i> This effort supported the expansion upon the current on board vehicle power program by investigating the possibility of providing this technology on other ground vehicle platforms such as the new HMMWV variants: ECV and ECV-II, and MRAP vehicle variants. Stationary and on the move vehicle power is	2.393	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602236N: <i>Warfighter Sustainment Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
a combat multiplier that enables U.S. forces to increase their mission range, duration, and efficiency while reducing the logistical burden of the small unit.		
Congressional Add: Optimization of New Marine Coatings  <i>FY 2009 Accomplishments:</i> This effort supported the application of capabilities in combinatorial coatings synthesis, formulation and characterization to the development of marine anti-fouling and fouling release coatings.	1.596	0.000
Congressional Add: PULSE Virtual Clinical Learning Lab  <i>FY 2009 Accomplishments:</i> This effort supported active virtual environment infrastructures using game-base technologies at the Virtual Clinical Learning Lab.	2.393	0.000
Congressional Adds Subtotals	22.180	15.057
<b>C. Other Program Funding Summary (\$ in Millions)</b>		
N/A		
<b>D. Acquisition Strategy</b>		
N/A		
<b>E. Performance Metrics</b>		
Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	61.439	69.327	83.902	0.000	83.902	80.672	86.146	85.615	89.534	Continuing	Continuing
0000: Electromagnetic Systems Applied Research	56.413	64.547	83.902	0.000	83.902	80.672	86.146	85.615	89.534	Continuing	Continuing
9999: Congressional Adds	5.026	4.780	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	42.582
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymetric warfare.</p>											
<p>The Electromagnetic Systems Applied Research Program addresses technology needs associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The program supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. This program directly supports the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities and efforts within this Program have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&amp;T) and Joint, Navy, and Marine Corps commands worldwide.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0602271N: Electromagnetic Systems Applied Research			
BA 2: Applied Research					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	59.668	64.816	0.000	0.000	0.000
Current President's Budget	61.439	69.327	83.902	0.000	83.902
Total Adjustments	1.771	4.511	83.902	0.000	83.902
• Congressional General Reductions		-0.289			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		4.800			
• Congressional Directed Transfers		0.000			
• Reprogrammings	2.867	0.000			
• SBIR/STTR Transfer	-1.096	0.000			
• Program Adjustments	0.000	0.000	83.902	0.000	83.902
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Silicon Carbide Wafer Production- Process Development For Low Defect Power Electronics					
Congressional Add: Energy Efficient Gallium Nitride Semiconductor Technology					
Congressional Add: Gallium Nitride RF Power Technology					
Congressional Add: National Initiatives for Applications of Multifunctional Materials					
Congressional Add: Reparative Core Medicine					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602271N: <i>Electromagnetic Systems Applied Research</i>	
<p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602271N: <i>Electromagnetic Systems Applied Research</i>				<b>PROJECT</b> 0000: <i>Electromagnetic Systems Applied Research</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Electromagnetic Systems Applied Research</i>	56.413	64.547	83.902	0.000	83.902	80.672	86.146	85.615	89.534	Continuing	Continuing

## **A. Mission Description and Budget Item Justification**

This project addresses technology opportunities associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The project supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. This project directly supports the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities and efforts within this program have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

## **B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>ELECTRONIC AND ELECTROMAGNETIC SYSTEMS</b>	13.611	17.666	30.700	0.000	30.700
<p>This R2 activity is devoted to mid-term technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated program of record. These Future Naval Capability (FNC) Enabling Capabilities (EC's) span across the Electronics, EW, Radar, Communications, and other technology areas supporting Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR). This R2 activity also appears in PE 0603271N. For Enabling Capabilities (EC) receiving funding from both PE's the PE 0602271N portion is generally focused on component design and development while the funding from PE 0603271N is focused on integration and demonstration. The specific objectives of the current EC's are:</p> <p>a) Next Generation Airborne Electronic Attack: Develop and demonstrate advanced capability Airborne</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide Suppression of Enemy Air Defenses (SEAD), deliver Non-Kinetic Fires, counter Integrated Air Defense Systems (IADS), and provide suppression of Command, Control & Communications (C3) links and data networks.						
b) Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missiles (ASBM) Defense: Improve ship survivability by disrupting the terminal engagement phase of hostile anti-ship cruise and ballistic missiles, including improvements to both onboard (Enhanced Surface Electronic Warfare Improvement Program,(SEWIP)) and offboard (Nulka) radio frequency (RF) Electronic Attack systems.						
c) Next Generation Countermeasure Technologies for Ship Missile Defense: Develop and demonstrate the fundamental technologies required to conduct next generation, persistent Electronic Warfare (EW) in support of ship, sea base, and littoral force missile defense operations in a distributed, coordinated manner across the entire battlespace.						
d) Long Range Detection and Tracking: Develop capability for simultaneous full volume radar coverage of contacts at long ranges and in a dense contact environment.						
e) Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: Develop and demonstrate electronics components technologies using wide bandgap semiconductors, mixed signal analog and digital, RF, microwave, millimeter wave and associated passive components thus enabling high efficiency transmitter element chains for arrays.						
f) Affordable Common Radar Architecture: Develop a common affordable, scalable, open radar architecture that provides affordable capability improvements and addresses total ownership cost challenges for 5 different radars.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
g) Low Cost over the Horizon Communications, Satellite Communications (SATCOM) and Line of Sight (LOS) Apertures: Develop technologies that provide the tools to implement a wideband tactical communications infrastructure. Developments will include techniques for LOS relay and routing using airborne platforms, as well as a SATCOM on-the-move capability for United States Marine Corps (USMC) tactical ground vehicles. Also included are technologies for pointing and tracking of airborne platforms, open architecture radio technologies, communications security (COMSEC), networking, and airborne apertures necessary for airborne relay and routing. Further developments include techniques for integrating multiple shipboard apertures in a limited space, cosite mitigation and the investigation of digital radio technologies that permit digitization at the aperture itself.						
h) SATCOM Vulnerability Mitigation: Develop technologies for mitigating SATCOM vulnerabilities using a wideband airborne and air-to-surface infrastructure. Technologies include approaches for development of ultra-low cost phased arrays and techniques for mitigating multi-path and scintillation on communications links. Architecture and application development will include surface-to-air communications in the 14-17 gigahertz (GHz) band, and air-to-air communications in the millimeter wave bands. Additionally, advanced techniques for the use of the ultra high frequency (UHF) spectrum will be developed which include beam forming techniques and alternative waveform designs that are used to support high bandwidth infrastructure establishment and control.						
i) Radar Electronic Attack Protection (REAP): Develop single platform precision passive electronic support measure (ESM) and electronic protection (EP) techniques and technology to counter hostile use of modern electronic attack (EA) self protection jammers.						
j) Global Applications for Data Exfiltration (GLADEX): Develop a nano-sat satellite bus with all its requisite structural, power, thermal, control, and separation subsystems and a nano-satellite compatible payload and ground terminal for monitoring and relay of unattended sensor data for global situational						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
awareness.						
k) Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3: Develop integrated RF communications and RF jammer capability that addresses the electromagnetic interference (EMI) issue to enable interoperability.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
The increase from FY 2009 to FY 2010 is associated with initiation of new FNC efforts in the Countermeasure Technologies for Anti-Ship Missile Defense Enabling Capabilities program.						
The increase from FY 2010 to FY 2011 is associated with the following: - Initiation of the two new Enabling Capabilities: the Radar Electronic Attack Protection (REAP) and the Global Applications for Data EXfiltration (GLADEX). - Additional emphasis in two ongoing Enabling Capabilities: Countermeasures Technologies (Surface Electronic Warfare Improvement Program (SEWIP)) and the SATCOM Vulnerability Mitigation. - JCREW 3.3 research effort.						
FY 2009 Accomplishments: Next Generation Airborne Electronic Attack: - Continued the development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing. - Continued the Next Generation Airborne Electronic Attack (NGAEA) effort by conducting a requirements validation and technology assessment review.						
Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missile (ASBM) Defense:						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued establishment of an industrial standard appropriate for the demonstration of greater than 106(&gt;1E6) hour lifetime for RF life testing of Gallium Nitride (GaN) based Monolithic Microwave Integrated Circuits (MMICs) and devices, and began to apply this standard to state-of-the-art (SOA) MMICs and devices.</li><li>- Continued the Enhanced Nulka Payload FNC effort by conducting a Transmitter and Receiver Technology Trade Space study.</li><li>- Continued the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by conducting a Transmitter and Cooling Technology Trade Space study.</li></ul> <p>Long Range Detection and Tracking:</p> <ul style="list-style-type: none"><li>- Continued demonstration of packaging techniques to provide cost reduction and affordability for modules, including component architecture, packaging, and scale of integration optimization.</li><li>- Continued design and development of a X-Band Digital Array Radar (DAR).</li><li>- Continued development of Maritime Classification and Identification modes for APY-6.</li></ul> <p>Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms:</p> <ul style="list-style-type: none"><li>- Continued effort on Affordable Electronically Scanned Array Technology to include electronics component technologies supporting S-band radar, X-band radar and electronic attack.</li></ul> <p>Low Cost over the Horizon Communication, Satellite SATCOM and LOS Apertures:</p> <ul style="list-style-type: none"><li>- Continued development of technology to provide a set of apertures (LOS, Satellite Communications) and link electronics that are suitable for broad Naval applications.</li><li>- Continued development of technology to provide open, programmable core terminal components applicable to multiple platforms to include airborne applications and Marine vehicles.</li></ul> <p>FY 2010 Plans:</p> <p>Next Generation Airborne Electronic Attack:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missile (ASBM) Defense: - Continue all efforts of FY 2009.						
Next Generation Countermeasure Technologies for Ship Missile Defense: - Initiate the Next Generation Countermeasures Technologies for Ship Missile Defense effort by development of techniques and technology for coordination of offboard surface/air EW payloads to achieve wide area protection for defense against anti-ship missiles.						
Long Range Detection and Tracking: - Continue all efforts of FY 2009. - Complete development of full volume surveillance capability of the DAR advanced development model prototype.						
Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue all efforts of FY 2009.						
Affordable Common Radar Architecture (ACRA): - Initiate development of an Affordable Common Radar Architecture to improve supportability and performance of multiple legacy radars.						
Low Cost over the Horizon Communication, SATCOM and LOS Apertures: - Continue all efforts of FY 2009.						
SATCOM Vulnerability Mitigation: - Initiate wideband infrastructure architecture design and development, development of alternative waveforms and development of advanced techniques for use of the spectrum.						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate development of technology components (e.g., phased arrays/apertures, cosite and fade mitigation techniques, advanced high band (14-17 GHz) signal processing radios) needed to support a wideband airborne infrastructure.</p> <p><i>FY 2011 Base Plans:</i> Next Generation Airborne Electronic Attack: - Continue all efforts of FY 2010.</p> <p>Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missile (ASBM) Defense: - Continue all efforts of FY 2010. - Initiate redesign and fabrication of a new cooling method due to an increase in the junction temperature from DARPA's Government Furnished Equipment (GFE) amplifier. - Initiate redesign and fabrication of a new amplifier mounting design which is required to accommodate the reduction of amplifier temperatures.</p> <p>Next Generation Countermeasure Technologies for Ship Missile Defense: - Continue all efforts of FY 2010.</p> <p>Long Range Detection and Tracking: - Continue all efforts of FY 2010 less those noted as completed above. - Complete demonstration of full volume surveillance capability of the DAR advanced development model prototype.</p> <p>Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue all efforts of FY 2010.</p> <p>Affordable Common Radar Architecture (ACRA):</p>					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continue all efforts of FY 2010.</p> <p>Low Cost over the Horizon Communication, SATCOM and LOS Apertures:</p> <p>- Continue all efforts of FY 2010.</p> <p>- Complete development of low cost satellite, airborne and shipboard apertures; demonstrate components in laboratory and realistic field environments.</p> <p>SATCOM Vulnerability Mitigation:</p> <p>- Continue ramp up of all architecture development efforts, and multi-year development efforts for waveforms and technology components cited above which were initiated in FY 2010.</p> <p>Radar Electronic Attack Protection (REAP):</p> <p>- Initiate a Network "Sentric" Electronic Protection (EP) capability by developing hardware, software and algorithms to achieve a multi-platform networked EP.</p> <p>- Initiate the Identification and Defeat of Electronic Attack Systems (IDEAS) FNC effort by developing single platform precision passive electronic support measure (ESM) and EP techniques and technology to counter hostile use of modern electronic attack self protection jammers.</p> <p>Global Applications for Data Exfiltration (GLADEX):</p> <p>- Initiate the development of a spacecraft bus structure, thermal, power, control, and command/telemetry systems for 3-axis, maneuverable, 30cm cube, 10kg, 10watt orbital average nano-satellite.</p> <p>- Initiate the development of launch dispensing separation mechanisms.</p> <p>- Initiate the development of a multi-function Data-Ex payload and ground terminal for reception of low rate (&lt;9600 bits/sec) VHF - UHF transmissions.</p> <p>Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3:</p> <p>- Initiate JCREW 3.3 architecture analysis and design.</p> <p>- Initiate JCREW 3.3 component development.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
ELECTRONIC WARFARE TECHNOLOGY	16.107	17.797	23.311	0.000	23.311
<p>The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Electronic Warfare (EW) systems across the entire electromagnetic spectrum that will increase the operational effectiveness and survivability of U.S. Naval units. Emphasis is placed on passive sensors and active and passive countermeasure (CM) systems that exploit and counter a broad range of electromagnetic threats. The focus is on maintaining near perfect real-time knowledge of the enemy; countering the threat of missiles against deployed Naval forces; precision identification and location of threat emitters; and development of technologies that have broad application across multiple disciplines within the EW mission area. This activity also includes developments to protect these technologies from external interference and modeling and simulation required to support the development of these technologies. The current specific objectives are:</p> <p>a) Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest: Develop sensors for the purpose of detection, localization, and identification of hostile signals of interest anywhere in the electromagnetic spectrum to provide autonomous and persistent Intelligence, Surveillance, and Reconnaissance (ISR) to forward deployed forces and detecting/identifying terrorists/ hostiles and their communications networks.</p> <p>b) Components and Advanced Architectures/Signal Processing Designs: Develop components and advanced architectures/signal processing designs to ensure effective and reliable threat detection of hostile emissions in dense environments.</p> <p>c) Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: Develop countermeasures and techniques to defeat advanced RF guided threats to protect high value assets from advanced weapon attack, develop forward deployed jamming systems to negate advanced RF surveillance systems, and deny enemy usage of Global Positioning System (GPS) navigation.</p>					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
d) Countermeasures and Techniques to Defeat Advanced Electro-Optic/Infrared (EO/IR) Guided Threats: Develop countermeasures and techniques to defeat advanced EO/IR guided threats to protect high value assets from advanced weapon attack, disrupt and attack EO/IR ISR assets, and provide false/misleading information to hostile EO/IR targeting and tracking systems.						
e) Modeling and Simulation: Use modeling and simulation to assess the effectiveness of Electronic Attack (EA) engagements to develop an understanding of adversary threat characteristics to support countermeasures technique requirements/development and assess/predict engagement effectiveness to optimize combat system engagement resources.						
f) Electronic Protection from Electromagnetic Interference (EMI) and EA: Develop Electronic Protection (EP)/Electronic Counter-Countermeasures (ECCM) to prevent the disruption and denial of U.S. Naval RF and EO/IR sensors and systems from both unintentional EMI and intentional EA and permit unimpeded usage of the electromagnetic spectrum by U.S. and allied forces.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
The increase from FY 2010 to FY 2011 is due to initiation of research to develop Countermeasures and Techniques to Defeat Advanced EO/IR Guided Threats.						
FY 2009 Accomplishments: Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest: - Continued technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Aerial Vehicles (UAVs), and EW Enabling Technology. - Continued the development of techniques to identify and exploit the processing vulnerability of passive location systems.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated the Digital Directional Correlator effort by building and refining a more complete simulation of the correlator and determining via simulation and analysis the primary characteristics required for the system.</p> <p>Components and Advanced Architectures/Signal Processing Designs:</p> <ul style="list-style-type: none"><li>- Continued development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.</li><li>- Continued development of a novel approach to near real time active digital augmentation to improve the isolation of shipboard EW systems.</li><li>- Initiated the Miniature 2-70 GHz Integrated Optical Channelizer effort by starting Phase I and specifications development.</li><li>- Initiated the Cueing Receiver for Faster EA Response Management effort by beginning system design.</li><li>- Initiated the Antennas from VHF to THz effort through development of the log-periodic antenna.</li><li>- Initiated the Exploiting Non-Traditional Signals Using a Photonics Based Signal Processor effort by performing proof-of-concept demonstrations for the three main modes of operation for the spatial spectral optical materials when used for Electronics Support Measures (ESM) applications.</li></ul> <p>Countermeasures and Techniques to Defeat Advanced RF Guided Threats:</p> <ul style="list-style-type: none"><li>- Continued the investigation of Millimeter Wave (MMW) technologies to support the development of off board and onboard countermeasures.</li><li>- Continued the assessment of the electronic protection capability of modern missiles using advanced processing and investigated the improvements needed to restore countermeasures effectiveness.</li><li>- Completed the design and development of a miniature coherent transponder to counter modern threats using advanced electronic protection techniques.</li><li>- Completed the development of a series of kinetically driven devices to generate RF.</li><li>- Initiated research for development of power amplifiers for future RF systems.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Modeling and Simulation: - Continued the EW Tactical Decision Algorithm (TDA) for Satellite Communications effort by evaluating two atmospheric propagation models to assist in visualizing the impact of satellite communications on future planning and tactics.  Acquisition Workforce Fund: - Funded DoD Acquisition Workforce Fund.  FY 2010 Plans: Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest: - Continue all efforts of FY 2009. - Continue the development of techniques to identify and exploit the processing vulnerability of passive location systems. Transferred from PE 0602271N Supporting Technologies. - Complete the Digital Directional Correlator (DDC) effort capable of detecting, identifying, and measuring the directional azimuth and elevation of all RF emitters (including frequency hoppers) within a 360 degree field of view in a single circular sweep.  Components and Advanced Architectures/Signal Processing Designs: - Continue all efforts of FY 2009. - Complete the Miniature 2-70 GHz Integrated Optical Channelizer (IOC) effort by fabricating and demonstrating the second generation IOC. - Complete the Exploiting Non-Traditional Signals Using a Photonics Based Signal Processor effort that will rapidly and accurately detect and identify non-traditional RF signals including spread spectrum, frequency hopping, noise-like waveforms, and unintentional RF emissions. - Complete the Cueing Receiver for Faster EA Response Management effort by integrating the receiver into the Naval Post Graduate School's photonic, single-bit 1st order sigma-delta digital antenna to test and evaluate the new architecture's ability to digitize wideband signals directly at the antenna.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete the Antennas from VHF to THz effort by testing the final combo antenna from 0.03-110 GHz.</li><li>- Initiate the Direction Finding of Low Probability of Intercept (LPI) Emitters effort by commencing digital algorithm development.</li></ul> <p>Countermeasures and Techniques to Defeat Advanced RF Guided Threats:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li><li>- Complete the development to assess the electronic protection capability of modern missiles using advanced processing and investigate the improvements needed to restore countermeasures effectiveness. Transferred from PE 0602271N Supporting Technologies.</li><li>- Initiate the Concurrent Multi-Spectral RF Carrier Generator effort to develop a single-chip, low power multi-spectral RF jamming sub-system that has programmable and automatic random mode switching and nanosecond frequency hopping over 1-18 GHz.</li></ul> <p>Countermeasures and Techniques to Defeat Advanced EO/IR Guided Threats:</p> <ul style="list-style-type: none"><li>- Initiate efforts to Detect and Deny EO/IR ISR Systems by developing passive and active detection systems using advanced Focal Plane Array (FPA)-based sensors and multi-spectral laser transmitters.</li><li>- Initiate efforts to Detect and Defeat Imaging IR sensors by developing laser-based countermeasures and advanced IR expendable decoys.</li></ul> <p>Modeling and Simulation:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete the EW Tactical Decision Algorithms (TDA) for Satellite Communications effort by evaluating two atmospheric propagation models to assist in visualizing the impact of satellite communications on future planning and tactics.</li><li>- Initiate the Real-Time EA Effectiveness Monitoring effort to assess the effectiveness in real-time of jamming an RF guided missile by exploiting the missile's RF transmission characteristics.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate the Integrated Onboard/Offboard EA Effectiveness effort by starting investigation with offboard decoy waveforms and structured ship targets.</p> <p>Electronic Protection from EMI and EA:</p> <p>- Initiate efforts for Electronic Protection of RF Sensors by developing passive and active techniques to adaptively process RF signals in EA denied and RF saturation environments.</p> <p>- Initiate efforts for Electronic Protection of EO/IR Sensors by developing passive and active techniques to adaptively filter EO/IR radiation in EA denied and EO/IR saturation environments.</p> <p><i>FY 2011 Base Plans:</i></p> <p>Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest:</p> <p>- Continue all efforts of FY 2010 less those noted as completed above.</p> <p>Components and Advanced Architectures/Signal Processing Designs:</p> <p>- Continue all efforts of FY 2010 less those noted as completed above.</p> <p>- Complete the Direction Finding of LPI Emitters effort by conducting field testing</p> <p>Countermeasures and Techniques to Defeat Advanced RF Guided Threats:</p> <p>- Continue all efforts of FY 2010 less those noted as completed above.</p> <p>- Complete the Concurrent Multi-Spectral RF Carrier Generator effort by fabricating and testing an RF carrier generator with the capability of generating up to 5 simultaneous asynchronous frequencies and controlled chaotic waveforms within 1-18GHz.</p> <p>Countermeasures and Techniques to Defeat Advanced EO/IR Guided Threats:</p> <p>- Continue all efforts of FY 2010.</p> <p>- Initiate the Multi-Wavelength Laser with Broad Spectrum Coverage effort by commencing quantum cascade (QC) and interband cascade (IC) chip design and fabrication in Band 4a.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate the High Power Long Wave Infrared (LWIR) QC Lasers for Shipboard Infrared Countermeasures (IRCM) effort with device design and thermal modeling tasks.</p> <p>- Initiate the Layered Multi-band Obscurant effort by commencing numerical analysis to optimize the predicted performance of potential materials for macroparticle design and fabrication.</p> <p>- Initiate the Directed Energy Defeat of Multi-Mode Threats effort by measuring missile seeker interference effects.</p> <p>Modeling and Simulation:</p> <p>- Continue all efforts of FY 2010 less those noted as completed above.</p> <p>- Complete the Real-Time EA Effectiveness Monitoring effort by finalizing prototype integration and conducting concept demonstration field testing.</p> <p>- Complete the Integrated Onboard/Offboard EA Effectiveness effort by developing robust Measures of Effectiveness (MOE) for onboard/offboard field trials.</p> <p>Electronic Protection from EMI and EA:</p> <p>- Continue all efforts of FY 2010.</p>						
EO/IR SENSOR TECHNOLOGIES		0.000	7.022	7.324	0.000	7.324
The overarching objective of this thrust is to develop technologies that enable the development of affordable, wide area, persistent surveillance optical architectures, day/night/all weather, adaptable, multi-mission sensor technology comprised of optical sources, detectors, and signal processing components for search, detect, track, classify, identify (ID), intent determination, and targeting applications and includes developments to protect these technologies from external interference. Also included are modeling and simulation required to support the development of these technologies. Efforts will also include the development of optical RF components, infrared technologies including lasers and focal plane arrays using narrow bandgap semiconductors. The current specific objectives are:						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
a) Optically Based Terahertz (THz) and Millimeter Wave Distributed Aperture Systems: Develop optically based terahertz (THz) and millimeter wave distributed aperture systems for imaging through clouds, fog, haze and dust on air platforms.						
b) Wide Area Optical Architectures: Develop wide area optical architectures for persistent surveillance for severely size constrained airborne applications.						
c) High Power Laser Sources: Develop high power laser sources for countermeasure and active imaging applications.						
d) Dynamic, Adaptable Wide Field-of-View (WFOV)/Narrow Field-of-View (NFOV) Surveillance and Sensor Technology: Develop dynamic, adaptable WFOV/NFOV surveillance and sensor technology for airborne surveillance, identification, and targeting applications.						
e) Non-cryogenically Cooled Infrared Photon Detectors: Develop non-cryogenically cooled infrared photon detectors for compact sensors on severely power constrained platforms.						
f) UAV Deployable Infrared (IR) Sensor Payloads: Develop UAV deployable EO/IR sensor payloads for persistent surveillance missions. Efforts in this activity were transferred from the Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies activity within PE 0602114N.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
In FY 2010, EO/IR efforts previously detailed in the FY 2009 Electronic Warfare Technology Activity are being consolidated into this new activity to provide improved justification of the nature of the funded						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
research and better alignment with future naval needs. Likewise, related research formerly funded and justified in the Navigation, EO/IR and Sensor Technologies Activity in PE 0602114N is being consolidated into this PE and R2 Activity beginning in FY 2010. Funding levels associated with the consolidated efforts are consistent with prior year totals.						
FY 2010 Plans: Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems: - Continue to perform field demonstration and testing of 94 gigahertz (GHz) passive millimeter wave (MMW) imager. Transferred from PE 0602114N. - Continue the development of techniques to combine current EO/IR technology and recent findings on the characteristics of the eye to classify and identify optical devices and individuals in real time at militarily significant ranges. Transferred from PE 0602114N. - Continue the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenging environments. Transferred from PE 0602114N. - Complete the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. Transferred from PE 0602114N. - Complete the development of an active optics system that can survey a wide area and instantly, nonmechanically zoom-in on an area of interest for target tracking/identification. Transferred from PE 0602114N. - Initiate miniaturization and modularization of MMW imaging system components for small platform systems.						
Wide Area Optical Architectures: - Continue development of ultra-high-sensitivity detectors suitable for use in focal plane arrays (FPAs) for the Shortwave Infrared (SWIR) spectral band. Transferred from PE 0602114N. - Continue development of mid and long wave IR focal plane arrays using graded-bandgap Wtype-II superlattices with much higher detectivity than state-of-the-art Mercury Cadmium Telluride						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(HgCdTe,MCT) FPAs. Transferred from PE 0602114N. - Complete field and flight testing of foveated zoom imager. Transferred from PE 0602114N - Complete system integration and test of optically agile zoom imager. Transferred from PE 0602114N. - Initiate design of read-out integrated circuits for temporally adaptive focal plane arrays. - Initiate development of spectrally agile visible, near-infrared, short-wave infrared and midwave infrared imaging technology. - Initiate integration of optically and temporally adaptable imaging technologies into sensor for networked persistent surveillance system.  High Power Laser Sources: - Complete development of high power fiber lasers in MWIR (2-5 1/4m) based upon highly nonlinear IR transmitting chalcogenide photonic crystal fibers. Transferred from PE 0602114N.  FY 2011 Base Plans: Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems: - Continue all efforts of FY 2010 less those noted as completed above. - Complete demonstration and testing of 94 GHz passive MMW imaging system. - Complete the development of techniques to combine current EO/IR technology and recent findings on the characteristics of the eye to classify and identify optical devices and individuals in real time at militarily significant ranges. - Complete the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenging environments. - Initiate integration of spectrally agile multi-band sensors into integrated system for use in persistent and time critical surveillance. - Initiate processing architecture for data analysis and fusion of multi-spectral images.  Wide Area Optical Architectures:					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Complete effort to develop ultra-high-sensitivity detectors suitable for use in focal plane arrays (FPAs) for the short-wave infrared (SWIR) spectral band. Transferred from PE 0602114N.</li><li>- Complete integration of optically and temporally adaptable imaging technologies into sensor for networked persistent surveillance system.</li></ul>						
NAVIGATION TECHNOLOGY  The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using the GPS, non-GPS navigation devices, and atomic clocks. This project will increase the operational effectiveness of U.S. Naval units. Emphasis is placed on GPS Anti-Jam (AJ) Technology; Precision Time and Time Transfer Technology; and Non-GPS Navigation Technology (Inertial aviation system, bathymetry, gravity and magnetic navigation). The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost Inertial Navigation Systems (INS). The current specific objectives are:  a) GPS AJ Antennas and Receivers: Develop anti-jam and anti-spoofers antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of emerging electronic threats.  b) Precision Time and Time Transfer Technology: Develop tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time, and the capability of transferring precision time via radio frequency links precision time.  c) Non-GPS Navigation Technology: Develop inertial/bathymetric/gravity navigation system for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals.		3.468	2.738	2.835	0.000	2.835

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>GPS Anti-Jam Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Continued the development of GPS AJ Antenna Electronics (AE) with low-cost analog processor technique for Direction of Arrival (DOA) estimation and nulling (up to 60dB nulling capability).</li><li>- Continued the development of Space-Frequency Adaptive Processing (SFAP) for GPS Anti-Spoofers using the existing Code Gated Maximum Likelihood (CGML) receiver.</li><li>- Completed the Advanced Spoofers Mitigation and Geolocation through Spoofers Tracking project.</li><li>- Completed the development of GPS Anti-Spoofers Test Facility.</li><li>- Completed the installation of GPS simulator with GAS-1 and other antennas in an anechoic chamber and conduct tests for four GPS AJ systems.</li><li>- Completed the GPS Anti-spoofers mitigation by DOA project.</li><li>- Completed the Acquisition Problem in Deeply Integrated GPS Systems project.</li><li>- Initiated the GPS Dual Receiver Hot Start Acquisition (DRHSA) project.</li><li>- Initiated the GPS Threat Assessment project.</li><li>- Initiated the Multi-Frequency Continuously Operating GPS Anomalous Event Monitor (GAEM) project.</li><li>- Initiated the Precise at-Sea Ship System for Indoor Outdoor Navigation (PASSION) project.</li></ul> <p>Precision Time and Time Transfer Technology:</p> <ul style="list-style-type: none"><li>- Continued the Self-Locked Intra-Cavity Alkali Vapor Laser (ICAL) Opto-Atomic Clock project.</li><li>- Completed the Precise and Accurate Stamping for Time Transfer Applications project.</li><li>- Initiated the Evolved Global Navigation Satellite System (GNSS) Signal Monitoring Receiver Element project.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>Non-GPS Navigation Technology:</p> <ul style="list-style-type: none"><li>- Continued the Deeply Integrated Navigation Grade GPS Inertial System project.</li><li>- Continued the Micro Fiber Optical Gyro (MFOG) project.</li><li>- Continued the Ship's Passive Inertial Navigation System (SPINS) project.</li><li>- Completed the Improved GPS/INS Integration using a Particle Filter Accelerator project.</li><li>- Initiated the Sonar Aided Inertial Navigation Technology (SAINT) project.</li><li>- Initiated the Optically Transduced Inertial Navigation System (INS) Sensor Suite (OPTIMUSS) project.</li></ul> <p><i>FY 2010 Plans:</i></p> <p>GPS AJ Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li></ul> <p>Precision Time and Time Transfer Technology:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li></ul> <p>Non-GPS Navigation Technology:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li><li>- Initiate development of the Three-Axis Resonant Fiber Optic-based Inertial Navigation System with the accuracy of 10 milli(m)-degrees per hour and the angle random walk (ARW) of 10 milli (m)-degrees per root hour.</li><li>- Initiate development of the SAINT system for littoral application; the SAINT will be applied to the existing Precision Underwater Mapping (PUMA) device.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <p>GPS Anti-Jam Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Complete GPS AJ Antenna Electronics effort.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete the SFAP for GPS Anti-Spoofers using the CGML receiver effort.</li><li>- Complete the DRHSA project.</li><li>- Initiate Time-transfer via IEEE 1588 effort.</li><li>- Initiate Military User Equipment Integrated Fault Analysis effort.</li></ul> <p>Precision Time and Time Transfer Technology:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Complete the ICAL Opto-Atomic Clock project.</li><li>- Initiate Advanced-Development of a Miniature Atomic Clock.</li></ul> <p>Non-GPS Navigation Technology:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Complete Deeply-Integrated GPS-INS project.</li><li>- Complete MFOG project.</li><li>- Complete SPINS project.</li><li>- Complete SAINT project.</li><li>- Complete SAINT-PUMA application.</li><li>- Initiate Micro-Electro-Mechanical System (MEMS) Gyro effort.</li></ul>						
SOLID STATE ELECTRONICS		0.000	7.975	8.149	0.000	8.149
The overarching objective of this activity is to develop higher performance components and subsystems for all classes of military RF systems that are based on solid state physics phenomena and are enabled by improved understanding of these phenomena, new circuit design concepts and devices, and improvements in the properties of electronic materials. An important subclass are the very high frequency (VHF), ultra-high frequency (UHF), microwave (MW), and millimeter wave (MMW) power amplifiers for Navy all-weather radar, surveillance, reconnaissance, electronic attack, communications, and smart weapons systems. Another subclass are the analog and high speed, mixed signal components that connect the electromagnetic signal environment into and out of digitally realized,						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
specific function systems. These improved components are based on both silicon (Si) and compound semiconductors (especially the wide bandgap materials and narrow bandgap materials), low and high temperature superconductors, novel nanometer scale structures and materials. Components addressed by this activity emphasize the MMW and submillimeter wave (SMMW) regions with an increasing emphasis on devices capable of operating in the range from 50 gigahertz (GHz) to 10 terahertz (THz). The functionality of the technology developed cannot be obtained through Commercial-Off-the-Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, operational and instantaneous bandwidth, weight, and size. Effort will involve understanding the properties of engineered semiconductors as they apply to quantum information science and technology. The current specific objectives are:						
a) Solid State Transistors and Devices: Develop solid state transistors and devices for high frequency analog and digital operation.						
b) High Efficiency, Highly Linear Amplifiers: Develop high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications.						
c) Superconducting Electronics: Develop components for RF systems utilizing superconducting and other technologies which are designed to deliver software defined, wide band, many simultaneous signal functionality over a wide range of frequencies, in increasingly field-ready packaging and demonstrate the ability of these components to be combined into chains to deliver superior functionality in conventional system contexts, including, but not limited to, SATCOM, Electronic Warfare (EW), signal intelligence (SIGINT), and communications.						
d) Control, Reception, and Processing of Signals: Develop electronics technology that provides for the control, reception, and processing of signals.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>e) Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: Develop novel nanometer scale (feature size at or below 10nm) logic/memory devices and related circuits and architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters.</p> <p>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.</p> <p>In FY 2010, efforts from Supporting Technologies and Solid State Power Amplifiers are being consolidated into this new activity to provide improved fidelity of efforts.</p> <p><i>FY 2010 Plans:</i></p> <p>Solid State Transistors and Devices:</p> <ul style="list-style-type: none"><li>- Continue development of Antimony (Sb)-based diodes and multipliers for the exploitation of the frequency spectrum from 94-1000 GHz. Transferred from PE 0602271N Supporting Technologies.</li><li>- Continue development of an integrated tunable frequency selective and low noise integrated module. Transferred from PE 0602271N Supporting Technologies.</li><li>- Continue effort to develop W-band high-power Gallium Nitride (GaN) Metal Insulator Semiconductor (MIS) transistors. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue MMW field plate GaN High Electron Mobility Transistor (HEMT) development. Transferred from PE 0602271N Solid State Power Amplifiers.</li></ul> <p>High Efficiency, Highly Linear Amplifiers:</p> <ul style="list-style-type: none"><li>- Continue development of MMW AlGaIn/GaN wide bandgap HEMT. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue development of AlGaIn HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers. Transferred from PE 0602271N Solid State Power Amplifiers.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue high-efficiency microwave GaN HEMT amplifier development. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue work on GaN MMW components at &gt;44 GHz to allow for EHF SATCOM insertion and other MMW applications spanning to 95GHz. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue the expansion of scope of the GaN MMW device program. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue component development in support of multifunctional electronic warfare. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue development of MMW high efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Continue Sub-MMW GaN Device technology for communications, target identification and high speed data processing. Transferred from PE 0602271N Solid State Power Amplifiers.</li><li>- Complete high efficiency S-Band GaN HEMT amplifier development. Transferred from PE 0602271N Solid State Power Amplifiers.</li></ul> <p>Superconducting Electronics:</p> <ul style="list-style-type: none"><li>- Continue development of a second generation superconducting digital channelizer which includes a 1xk multiplier. Transferred from PE 0602271N Supporting Technologies.</li><li>- Continue demonstration of an improved signal processing technique that can be applied to state-ofthe-art L, S, X, and Ka-band superconducting bandpass ADCs to realize an improvement in dynamic range of greater than 6dB. Transferred from PE 0602271N Supporting Technologies.</li><li>- Complete proof of concept demonstration of a wideband, high dynamic range combined LNA and antenna, based on arrays of superconducting quantum interference devices (SQUIDs) on a 1</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
centimeter squared (cm2) chip for frequencies below 200 megahertz (MHz). Transferred from PE 0602271N Supporting Technologies.						
Control, Reception, and Processing of Signals: - Continue development of an integrated tunable frequency selective and low noise integrated module. - Continue development of Gallium Nitride-based low-noise components for Interference Immune Navy Satcom receivers.						
Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: - Complete development of Cellular Nonlinear Network (CNN) processing techniques for unmanned air vehicle (UAV)landing applications. Transferred from PE 0602271N Supporting Technologies. - Continue effort to develop a highly linear, low-noise RF amplifier using aligned arrays of single-walled carbon nanotubes. Transferred from PE 0602271N Supporting Technologies. - Continue development of three dimensional (3D)-integrated CNN image sensing processing architecture research. Transferred from PE 0602271N Supporting Technologies.						
FY 2011 Base Plans: Solid State Transistors and Devices: - Continue all efforts of FY 2010. - Initiate mixed-signal GaN Monolithic Microwave Integrated Circuit (MMIC) technology development.						
High Efficiency, Highly Linear Amplifiers: - Continue all efforts of FY 2010 less those noted as completed above. - Initiate development of GaN Monolithic Microwave Integrated Circuit (MMIC) Amplifier Technology for operation greater than (>)100 GHz. - Initiate development of high efficiency GaN amplifier MMICs for 50-100 GHz operation.						
Superconducting Electronics:						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div><div><div>- Complete development of a second generation superconducting digital channelizer which includes a 1xk multiplier.</div><div>- Complete demonstration of an improved signal processing technique that can be applied to state-of-the-art L, S, X, and Ka-band superconducting bandpass ADCs to realize an improvement in dynamic range of greater than 6dB.</div><div>- Initiate development of first prototype of 1 cm squared HF-UHF antenna for space limited platforms such as UAVs.</div><div>- Initiate effort to improve superconducting analog to digital converter performance by more than 2 bits.</div></div><div>Control, Reception, and Processing of Signals:</div><div><div>- Continue all efforts of FY 2010.</div></div><div>Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures:</div><div><div>- Continue all efforts of FY 2010 less those noted as completed above.</div><div>- Complete development of three dimensional (3D)-integrated CNN image sensing processing architecture research.</div><div>- Initiate new research in graphene synthesis and device concepts.</div><div>- Initiate new effort in assessment of scalable nanoarchitectures.</div><div>- Initiate new effort in sub-10nm nanofabrication.</div></div></div>						
SOLID STATE POWER AMPLIFIERS  This activity provides for the generation of High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF), Micro Wave (MW), and Millimeter Wave (MMW) power amplifiers for Navy allweather radar, surveillance, reconnaissance, electronic attack, communications, and smart weapons systems. The technology developed cannot, for the most part, be obtained through Commercial-Off-the-Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, bandwidth, weight, and size.		4.182	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The current specific objective is: Develop high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications.</p> <p>All FY 2010 efforts in this activity have been transferred to the newly created Solid State Electronics activity to provide for better alignment between future naval needs and the solid state research being conducted.</p> <p><i>FY 2009 Accomplishments:</i> High Efficiency, Highly Linear Amplifiers for Microwave, Millimeter-Wave, Low-Noise, and Power Applications: - Completed high efficiency microwave Gallium Nitride High Electron Mobility Transistor amplifier development.</p> <p>Note: In addition to being performed here in FY 2009 the following efforts also transfer to the newlycreated Solid State Electronics activity in FY 2010. - Continued development of MMW Aluminum Gallium Nitride (AlGaN)/Gallium Nitride wide bandgap HEMT. - Continued development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers. - Continued MMW field plate GaN HEMT development. - Continued effort to develop W-band high-power GaN Metal-Insulator-Semiconductor (MIS) transistors. - Continued work on GaN MMW components at &gt;44 GHz to allow for Extremely High Frequency (EHF) SATCOM insertion and other MMW applications spanning to 95GHz. - Continued the expansion of scope of the GaN MMW device program.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued component development in support of multifunctional electronic warfare.</li><li>- Continued transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications.</li><li>- Continued development of MMW high efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems.</li><li>- Continued development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications.</li><li>- Continued Sub-MMW GaN Device technology for communications, target identification and high speed data processing.</li><li>- Initiated Sub-MMW GaN amplifier development.</li></ul>					
SUPPORTING TECHNOLOGIES  Supporting Technologies provide for the radiation, reception, signal control and processing of Very High Frequency (VHF), Ultra High Frequency (UHF), Micro Wave (MW), and Millimeter Wave (MMW) power for Navy all-weather radar, surveillance, reconnaissance, Electronic Attack (EA), communications, smart weapons, networked sensors, and precision time and navigation systems. Supporting Technologies is characterized by research outside of RF amplifiers, with emphasis in superconducting electronics and nanoelectronics technology. The technology developed which includes nanotechnology cannot, for the most part, be obtained through commercial off the shelf systems (COTS) as a result of the requirements placed on power, frequency, linearity, bandwidth, weight, and size. The current specific objectives are:  a) Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest Anywhere in the Electromagnetic Spectrum: Develop sensors for the purpose of detection, localization, and identification of hostile signals of interest anywhere in the electromagnetic spectrum to provide autonomous and persistent Intelligence, Surveillance, and Reconnaissance (ISR) to forward deployed forces and detecting/identifying terrorists/hostiles and their communications networks.	6.580	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
b) Countermeasures and Techniques to Defeat Advanced RF Guided Threats: Develop countermeasures and techniques to defeat advanced RF guided threats to protect high value assets from advanced weapon attack, develop forward deployed jamming systems to negate advanced RF surveillance systems, and deny enemy usage of GPS navigation.						
c) Solid State Transistors and Devices for High Frequency Analog and Digital Operation: Develop solid state transistors and devices for high frequency analog and digital operation.						
d) Superconducting Electronics: Develop components for RF systems utilizing superconducting and other technologies which are designed to deliver software defined, wide band, many simultaneous signal functionality over a wide range of frequencies, in increasingly field-ready packaging and demonstrate the ability of these components to be combined into chains to deliver superior functionality in conventional system contexts, including, but not limited to, SATCOM, EW, signal intelligence (SIGINT), and communications.						
e) Control, Reception, and Processing of Signals: Develop electronics technology that provides for the control, reception, and processing of signals.						
f) Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: Develop novel nanometer scale (feature size at or below 10nm) logic/memory devices and related circuits and architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters.						
g) New Concepts for Ultrasensitive, Nano-Based Sensors: Develop new concepts for ultrasensitive, nano-based sensors.						
All FY 2010 efforts in this activity have been transferred to the newly-created Solid State Electronics						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
activity to provide for better alignment with future naval needs.						
FY 2009 Accomplishments: Note: In addition to being performed here in FY 2009, the following efforts also transfer to the Electronic Warfare Activity in FY 2010.						
Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest Anywhere in the Electromagnetic Spectrum: - Continued development of techniques to identify and exploit the processing vulnerability of passive location systems.						
Countermeasures and Techniques to Defeat Advanced RF Guided Threats: - Continued development to assess the electronic protection capability of modern missiles using advanced processing and investigated the improvements needed to restore countermeasures effectiveness.						
Note: In addition to being performed here in FY 2009, the following efforts also transfer to the newly created Solid State Electronics Activity in FY 2010.						
Solid State Transistors and Devices for High Frequency Analog and Digital Operation: - Continued development of Antimony (Sb)-based diodes and multipliers for the exploitation of the frequency spectrum from 94-1000 GHz. - Initiated effort to develop W-band high-power Gallium Nitride (GaN) Metal Insulator Semiconductor (MIS) transistors.						
Superconducting Electronics: - Continued demonstration of an improved signal processing technique that can be applied to state-of-the-						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
art L, S, X, and Ka-band superconducting bandpass ADCs to realize an improvement in dynamic range of greater than 6dB. - Continued proof of concept lab demonstration of a wideband, high dynamic range combined LNA and antenna, based on arrays of superconducting quantum interference devices (SQUIDs) on a 1 centimeter squared (cm2) chip for frequencies below 200 megahertz (MHz). - Continued development of a second generation superconducting digital channelizer which includes a 1xk multiplier.  Control, Reception, and Processing of Signals: - Continued development of an integrated tunable frequency selective and low noise integrated module. - Initiated development of Gallium Nitride-based low-noise components for Interference Immune Navy Satcom receivers.  Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: - Continued development of Cellular Nonlinear Network (CNN) processing techniques for UAV landing applications. - Continued effort to develop a highly linear, low-noise RF amplifier using aligned arrays of singlewalled carbon nanotubes. - Continued development of three dimensional (3D)-integrated CNN image sensing processing architecture research.						
SURVEILLANCE TECHNOLOGY		8.949	7.965	8.170	0.000	8.170
The overarching objective of this activity is to develop advanced sensor and sensor processing systems for continuous high volume theater-wide air and surface surveillance, battle group surveillance, real time reconnaissance and ship defense. Major technology goals include long-range target detection						

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		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and discrimination, target identification (ID) and fire control quality target tracking in adverse weather, background clutter and electronic countermeasure environments and includes modeling and simulation required to support the development of these technologies. The current specific objectives are:						
a) Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: Develop radar architectures, sensors, and software which address Ballistic Missile and Littoral requirement shortfalls including: sensitivity; clutter rejection; and flexible energy management.						
b) Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration and Feature Extraction: Develop algorithms, sensor hardware, and signal processing techniques for automated radar based contact mensuration and feature extraction in support of asymmetric threat classification and persistent surveillance and to address naval radar performance shortfalls caused by: man-made jamming and Electronic Counter Measures (ECM), unfavorable maritime conditions, and atmospheric and ionosphere propagation effects.						
c) Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: Develop software, and hardware for a multi-platform, multi-sensor surveillance system for extended situational awareness of the battlespace.						
d) Small UAV Collision Avoidance/Autonomy Technology: Develop small UAV collision avoidance/ autonomy technology.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
FY 2009 Accomplishments: Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls:						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued the Horizon Extension Sensor System (HESS) project with form factored integration of High Power Amplifier (HPA) and development of a Silicon Germanium (SiGe) downconverter in support of HESS and Digital Array Radar (DAR) efforts.</p> <p>- Continued an element level DAR effort on down conversion and digital beam formers.</p> <p>- Initiated the requirements analysis and trade studies of an Advanced Common Radar Architecture.</p> <p>Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration and Feature Extraction:</p> <p>- Continued development efforts to demonstrate signal processing, waveform generation and one dimensional active phased array apertures for harbor surveillance and situational awareness.</p> <p>- Continued demonstrations of advanced Non-Cooperative Target Recognition (NCTR) algorithms in congested harbor environments.</p> <p>- Continued the assessment of vulnerabilities of modern side lobe canceling (SLC) algorithms to adversary jamming and develop mitigating SLC design improvements.</p> <p>- Continued the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenged environments.</p> <p>- Completed a program to develop and demonstrate methodologies that provide small threat radar detection in the presence of large masking radar returns using an Adaptive Pulse Compression technique.</p> <p>- Initiated investigation of means of optimally combining mensuration, classification, and noncooperative target recognition of surface craft.</p> <p>Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:</p> <p>- Continued the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment.</p> <p>Small UAV Collision Avoidance/Autonomy Technology:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated development of research technologies and analytical algorithms for an effective and highly reliable collision avoidance system.</p> <p><i>FY 2010 Plans:</i> Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: - Continue all efforts of FY 2009. - Initiate development of a millimeter wave active/passive identification sensor.</p> <p>Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction: - Continue all efforts of FY 2009 less those noted as completed above. - Complete the assessment of vulnerabilities of modern side lobe canceling (SLC) algorithms to adversary jamming and develop mitigating SLC design improvements. - Initiate development of a technology architecture for the Persistent Autonomous Surveillance System. - Initiate development of automated controls for an airborne persistent multi-node sensor network.</p> <p>Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: - Complete the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment.</p> <p>Small UAV Collision Avoidance/Autonomy Technology: - Continue all efforts of FY 2009.</p> <p><i>FY 2011 Base Plans:</i> Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continue all efforts of FY 2010.</p> <p>Algorithms, Sensor Hardware, and Signal Processing Techniques For Automated Radar Based Contact Mensuration And Feature Extraction:</p> <p>- Continue all efforts of FY 2010 less those noted as completed above.</p> <p>- Initiate development of algorithms and signal processing for Electronic Protection in airborne radars.</p> <p>- Initiate development of software and algorithms for multi-platform radar controls.</p> <p>Small UAV Collision Avoidance/Autonomy Technology:</p> <p>- Continue all efforts of FY 2010.</p>					
VACUUM ELECTRONICS POWER AMPLIFIERS	3.516	3.384	3.413	0.000	3.413
<p>The overarching objective of this activity is to develop millimeter wave (MMW) and sub-MMW power amplifiers for use in Naval all-weather radar, surveillance, reconnaissance, electronic attack, and communications systems. The technology developed cannot, for the most part, be obtained through commercial off the shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, bandwidth, weight, and size.</p> <p>Responding to strong interests from the various user communities, efforts are focused on the development of technologies for high-data-rate communications, electronic warfare and high-power radar applications at MMW and upper-MMW regime. The emphasis is placed on achieving high power at high frequency in a compact form factor. Technologies include utilization of spatially distributed electron beams in amplifiers, such as sheet electron beams and multiple-beams, and creation of simulation based design methodologies based on physics-based and geometry driven design codes. The current specific objectives are:</p> <p>a) High Power Millimeter and Upper Millimeter Wave Amplifiers: Develop science and technology for high power millimeter and upper millimeter wave amplifiers including high current density diamond cathodes, sheet and multiple electron beam formation and mode suppression techniques in overmoded</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
structures.						
b) Lithographic Fabrication Techniques: Develop lithographic fabrication techniques for upper-millimeter wave amplifiers.						
c) Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: Develop accurate and computationally effective device-specific multi-dimensional models for electron beam generation, large-signal and stability analysis to simulate device performance and improve the device characteristics.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
FY 2009 Accomplishments:						
High Power Millimeter and Upper Millimeter Wave Amplifiers:						
- Completed research effort on generation and transport of sheet beam with 5:1 aspect ratio.						
- Initiated the development of high-current-density cathodes based on diamond current amplifier.						
- Initiated effort to produce a compact, high-power, W-band amplifier by developing an extended interaction klystron circuit that will be mated to a novel sheet-beam gun, permanent magnet & collector.						
- Initiated the development of new spatially-distributed electron beam traveling-wave amplifier structures incorporating novel mode suppression techniques.						
Lithographic Fabrication Techniques:						
- Initiated effort to develop 220 GHz millimeter-wave amplifiers employing electromagnetic structures that are microfabricated using lithographic techniques.						
Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams:						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research		PROJECT 0000: Electromagnetic Systems Applied Research		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued effort on the gun/collector code MICHELLE with improved interface with the large signal codes CHRISTINE and Telegrapher's Equation Solution for Linear Amplifiers (TESLA).</li><li>- Continued the effort on developing algorithms and models in large signal code TESLA for multiple beam klystrons.</li><li>- Continued the effort on the development and implementation of models and algorithms in the large signal CHRISTINE 3D code to create capabilities for an end-to-end analysis of a Helix traveling wave tube (TWT).</li><li>- Continued the effort on the development and implementation of models and algorithms in a large signal klystron code to model sheet electron beam - wave interaction.</li><li>- Continued the effort on developing models and algorithms based on generalized model expansion (GENOME) techniques for large signal modeling of extended interaction klystrons (EIK).</li><li>- Completed the effort on developing and implementing models for multi-gap cavity coupling in TESLA for klystrons.</li><li>- Initiated the effort on the development and implementation of models and algorithms in a large signal TWT code to model sheet electron beam - wave interaction.</li><li>- Initiated the effort on the development of nonlinear stability analysis for broadband coupled cavity - traveling wave tube (CC-TWT).</li></ul> <p>FY 2010 Plans:</p> <p>High Power Millimeter and Upper Millimeter Wave Amplifiers:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li></ul> <p>Lithographic Fabrication Techniques:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p>Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li><li>- Complete nonlinear stability analysis for the broadband CC-TWT.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy							DATE: February 2010				
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research			R-1 ITEM NOMENCLATURE PE 0602271N: Electromagnetic Systems Applied Research			PROJECT 0000: Electromagnetic Systems Applied Research					
B. Accomplishments/Planned Program (\$ in Millions)											
						FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	
<div>- Complete an end-to-end analysis of a Helix TWT using the large signal CHRISTINE 3D code.</div> <div>- Initiate development of coupled-cavity 2D algorithms in TESLA for the CC-TWT.</div> <div>FY 2011 Base Plans:</div> <div>High Power Millimeter and Upper Millimeter Wave Amplifiers:</div> <div>- Continue all efforts of FY 2010.</div> <div>Lithographic Fabrication Techniques:</div> <div>- Continue all efforts of FY 2010.</div> <div>Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams:</div> <div>- Continue all efforts of FY 2010 less those noted as completed above.</div> <div>- Initiate development of parallel version of MICHELLE for gun/collector code to reduce computational time by factor of 10 for realistic 3D electron beams.</div>											
Accomplishments/Planned Programs Subtotals						56.413	64.547	83.902	0.000	83.902	
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0603271N: ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	19.594	24.586	31.782	0.000	31.782	39.723	29.845	24.876	6.109	0.000	176.515
D. Acquisition Strategy											
Not applicable.											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602271N: <i>Electromagnetic Systems Applied Research</i>	<b>PROJECT</b> 0000: <i>Electromagnetic Systems Applied Research</i>
<p><b>E. Performance Metrics</b></p> <p>This PE supports the development of technologies that addresses technology needs associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The program supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.</p> <p>Specific examples of metrics under this PE include:</p> <ul style="list-style-type: none"> <li>- Provide a secure, over the horizon, on-the- move capability to communicate with higher headquarters at a data rate of 256-512 Kbps at a cost of \$75,000.</li> <li>- Provide an array configuration suitable for installation on aircraft that will support TCDL data rates of 10.7 and 45 Mbps at greater than 150 nautical mile range.</li> <li>- Develop prototype Ku band phased array apertures in a form factor suitable for installation on the CVN-78.</li> </ul>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602271N: <i>Electromagnetic Systems</i> <i>Applied Research</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	5.026	4.780	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	42.582
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Silicon Carbide Wafer Production- Process Development For Low Defect Power Electronics  <i>FY 2010 Plans:</i> This effort supports Silicon Carbide Wafer Production-Process Development for LOW Defect Power Electronics research.							0.000	1.195			
Congressional Add: Energy Efficient Gallium Nitride Semiconductor Technology  <i>FY 2009 Accomplishments:</i> This effort supported the initiation of device design and development of fabrication processes for normally-off Gallium Nitride-based switches was investigated. The development of this technology will advance compact, efficient power conversion on mobile platforms.							1.037	0.000			
Congressional Add: Gallium Nitride RF Power Technology							1.596	1.593			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602271N: <i>Electromagnetic Systems</i> <i>Applied Research</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the process development of Gallium Nitride HEMTs and initiated studies for related processes for MMIC development. This effort contributes to the development of high volume manufacturing of reliable GaN-based RF components for Navy communications systems.		
<i>FY 2010 Plans:</i> Continues support of Gallium Nitride (GAN) Power Technology research.		
Congressional Add: National Initiatives for Applications of Multifunctional Materials  <i>FY 2009 Accomplishments:</i> This effort supported the development of these materials to enable new concepts in passive RF components for filter applications. Equipment was procured for the support of the multifunctional materials project.	1.595	1.992
<i>FY 2010 Plans:</i> Continues support of National Initiatives for Applications of Multifunction Materials research.		
Congressional Add: Reparative Core Medicine  <i>FY 2009 Accomplishments:</i> This effort supported the development of methods to permit the production of safe functioning blood cells for transfusion. The objective is to eliminate the need for human donors of blood.	0.798	0.000
Congressional Adds Subtotals	5.026	4.780

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602271N: <i>Electromagnetic Systems</i> <i>Applied Research</i>	PROJECT 9999: <i>Congressional Adds</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> Congressional Add.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				R-1 ITEM NOMENCLATURE PE 0602435N: <i>Ocean Wrfghtg Env Applied Res</i>							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	51.855	53.727	49.491	0.000	49.491	51.279	52.052	53.703	54.989	Continuing	Continuing
0000: <i>Ocean Wrfghtg Env Applied Res</i>	47.467	48.548	49.491	0.000	49.491	51.279	52.052	53.703	54.989	Continuing	Continuing
9999: <i>Congressional Adds</i>	4.388	5.179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	34.941
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This PE provides the unique, fundamental programmatic instrument by which basic research on the natural environment is transformed into technological developments that provide new or enhanced warfare capabilities for the Battlespace Environment (BSE). The objectives of this program are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting naval material and operations in the BSE. This program provides for BSE technological developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff, with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare.</p>											
<p>This PE fully supports the Director of Defense Research and Engineering's Science and Technology Strategy and is coordinated with other DoD Components through the Defense Science and Technology Reliance process. Work in this program is related to and fully coordinated with efforts in accordance with the on-going Reliance joint planning process. There is close coordination with the US Air Force and US Army under the Reliance program in the BSE categories of Lower Atmosphere, Ocean Environments, Space &amp; Upper Atmosphere, and Terrestrial Environments. Within the Naval Transformation Roadmap, the investment will contribute toward achieving each of the "key transformational capabilities" required by Sea Strike, Sea Shield, and Sea Basing. Moreover, environmental information, environmental models, and environmental tactical decision aids that emerge from this investment will form one of the essential components of FORCEnet (which is the architecture for a highly adaptive, human-centric, comprehensive maritime system that operates from seabed to space). The Navy program includes efforts that focus on, or have attributes that enhance, the affordability of warfighting systems.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0602435N: Ocean Wrfghtg Env Applied Res			
BA 2: Applied Research					
Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	51.538	48.750	0.000	0.000	0.000
Current President's Budget	51.855	53.727	49.491	0.000	49.491
Total Adjustments	0.317	4.977	49.491	0.000	49.491
• Congressional General Reductions		-0.223			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		5.200			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.862	0.000			
• SBIR/STTR Transfer	-0.545	0.000			
• Program Adjustments	0.000	0.000	49.491	0.000	49.491
• Rate/Misc Adjustments	0.000	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Autonomous Marine Sensors and Networks for Rapid Littoral Assessment					
Congressional Add: Underwater Imaging and Communications Using Lasers					
Congressional Add: Unmanned Undersea Vehicle Submerged Long Range Positioning					
Congressional Add: Extended Underwater Optical Imaging					
Congressional Add: Littoral Battlespace Sensing (LBS) & Autonomous Underwater Vehicle System (UAV)					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Technical: Not applicable.					

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602435N: <i>Ocean Wrfghtg Env Applied Res</i>	
<p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602435N: <i>Ocean Wrfghtg Env Applied Res</i>				<b>PROJECT</b> 0000: <i>Ocean Wrfghtg Env Applied Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Ocean Wrfghtg Env Applied Res</i>	47.467	48.548	49.491	0.000	49.491	51.279	52.052	53.703	54.989	Continuing	Continuing

## A. Mission Description and Budget Item Justification

This project provides technologies that form the natural environment technical base on which all systems development and advanced technology depend. Furthermore, this technical base provides developments that may be utilized in the Future Naval Capabilities programs: Organic Mine Countermeasures (MCM) and Autonomous Operations. This project contains the National Oceanographic Partnership Program (NOPP) (Title II, subtitle E, of Public Law 104-201) and efforts aimed at understanding and predicting the impacts of underwater sound on marine mammals.

Major efforts of this project are devoted to: gaining real-time knowledge of the BSE, determining the natural environment needs of regional warfare, providing the on-scene commander with the capability to exploit the environment to tactical advantage and, developing atmospheric research related to detection of sea-skimming missiles and strike warfare. This project provides natural environment applied research for all fleet operations and for current or emerging systems. Major developments are routinely transitioned to the Fleet Numerical Meteorology and Oceanography Center and to the Naval Oceanographic Office where they are used to provide timely information about the natural environment for all fleet operations.

Joint Littoral Warfare efforts address issues in undersea, surface, and air battlespace. Efforts include ocean and atmospheric analysis and prediction for real-time description of the operational environment, shallow water acoustics, multiple-influence sensors for undersea surveillance and weapon systems, and influences of the natural environment on MCM and Anti-Submarine Warfare (ASW) systems. Joint Strike Warfare efforts address issues in air battlespace dominance. Efforts include influences of the natural environment on air operations, electromagnetic (EM)/electro-optic (EO) systems used in intelligence, surveillance, reconnaissance, targeting, bomb damage assessment, and detection of missile weapon systems. They also include improvements in tactical information management about the BSE.

## B. Accomplishments/Planned Program (\$ in Millions)

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
Coastal Geosciences/Optics	5.587	5.926	6.653	0.000	6.653
The goal of this activity is to determine the sources, distribution, and natural variability (concentration					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and properties) of optically important matters in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare. Research investments in this activity support the development and testing of expendable and autonomous bioluminescence sensors, the continued development of extended range underwater imaging technologies, and algorithm development and testing for application to ocean color remote sensing from aircraft and space in order to characterize key features of the coastal battle space such as bathymetry, shallow-water bottom types, and the distribution of ocean water optical properties.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued to refine algorithms that fuse sediment information extracted from operational sonar with historical sediment databases.</li><li>- Continued development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provided demonstration.</li><li>- Continued experiments (and data collection) to test user performance as a function of display clutter.</li><li>- Continued efforts to develop visible/near infrared hyperspectral imagery algorithms for autonomous, near real time, retrieval of environmental products, such as diver visibility, bottom type and reflectivity, and bathymetry.</li><li>- Continued efforts to develop automatic coordination and utilization of distributed web services.</li><li>- Completed tracking analysis of small satellite calibration targets to determine atmospheric drag due to neutral density via Light Detection And Ranging (LIDAR) remote sensing.</li><li>- Initiated effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology, physical properties, and energetics.</li><li>- Initiated effort to develop and evaluate an integrated multi-sensor suite, including a small microflow cytometer, to characterize optical and biological properties of subsurface particle layers in coastal waters using unmanned underwater glider technology.</li><li>- Initiated effort to develop an intelligent decluttering algorithm (or system of algorithms) that accounts for both global and local clutter metrics in complex, multivariate displays.</li><li>- Initiated effort to develop a next generation atmospheric correction algorithm which will greatly enhance ocean passive retrievals including ocean color and visibility, bathymetry and sea surface</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602435N: Ocean Wrfghtg Env Applied Res		PROJECT 0000: Ocean Wrfghtg Env Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
temperature.  FY 2010 Plans: - Continue all efforts of FY 2009 less those noted as completed above. - Complete effort to develop visible/near infrared hyperspectral imagery algorithms for autonomous, near real time, retrieval of environmental products, such as diver visibility, bottom type and reflectivity, and bathymetry. - Complete effort to develop automatic coordination and utilization of distributed web services. - Complete bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and Naval Oceanographic Office survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence. - Initiate development of riverine expert system for environmental characterization.  FY 2011 Base Plans: - Continue all efforts of FY 2010 less those noted as completed above.						
Marine Mammals and Biology  This activity consolidates and expands research conducted in previous years in Coastal Geosciences/ Optics and the Physical Oceanography Activities and expands these efforts. The sensitivity of Marine Mammals to sound produced by Naval operations and training will continue. This program is to assure that Navy decisions can be based on entifically defensible positions.The goal of this activity is to support: (1) marine mammal research related to understanding impacts of sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; (3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine organisms; and (4) research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing		5.157	4.999	4.998	0.000	4.998

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of bioluminescence sensors). The marine mammals research conducted in this PE represents part of a total effort executed in coordination with complementary research performed in PE 0602747N.						
FY 2009 reflects the realignment of funds from the Coastal Geosciences/Optics R2 Activity to fund expansion of the marine mammal noise study/mitigation effort per CNO requirement and to reflect an overall trend in program direction toward ocean sciences.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued at-sea demonstration of radar and acoustics systems to monitor marine mammals in fleet activities. This effort moves to the Marine Mammals and Biology R2 activity in FY 2009.</li><li>- Completed an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet ASW experimentation exercises and demonstrations when sound is transmitted underwater. (This effort transitioned from the Coastal Geosciences/Optics R2 activity).</li><li>- Initiated multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures.</li><li>- Initiated development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery.</li><li>- Initiated research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts).</li><li>- Initiated research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters.</li><li>- Initiated development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise.</li><li>- Initiated development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated research to examine sensitivity of fish to anthropogenic sound.</li><li>- Initiated research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate research on the physiology and stress of marine mammals in the wild.</li></ul>						
Marine Meteorology  The marine atmosphere affects most aspects of naval operations. This activity develops observing technologies, models, Numerical Weather Prediction (NWP) systems and Tactical Decision Aids (TDA) that describe the atmospheric environment and its impacts on naval sensors and operations. This activity focuses on uniquely marine aspects of atmospheric science such as air-sea interaction, coupled ocean-atmosphere modeling, EM and EO propagation, coastal meteorology, Tropical Cyclone (TC) prediction, and the use of remote sensing to obtain quantitative observations of atmospheric properties. Aspects of the atmospheric environment of particular interest include near-surface phenomena that affect refractivity, marine boundary layer dynamics that affect clouds, rain, visibility and fog, and processes that control TC structure, track, and intensity. Objectives of this activity are improved NWP systems and TDAs that provide NOWCAST and forecast skill at global, regional, and tactical scales for operational support, sensor and system development, and performance prediction.  <i>FY 2009 Accomplishments:</i> Continued developments in atmospheric effects on EMs and EOs because of the central importance of EM and EO propagation to many modern warfare systems. <ul style="list-style-type: none"><li>- Continued development of an EO propagation model that accounts for the atmospheric effects of</li></ul>		10.459	10.861	10.312	0.000	10.312

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
near-surface refraction, scintillation, aerosol extinction, illumination and target, background and sensor characteristics for incorporation into EO tactical decision aids and for supporting warfare systems development. - Continued application of predictability concepts to optimize use of new-generation satellite data to target observation selection for maximum forecast impact in military areas of interest. - Continued exploitation of optimal methods for capturing uncertainty of environmental predictions on regional and local scales for reliability estimates of tactical parameters. - Continued program to develop the ability to assimilate data from the next generation of operational weather satellites to benefit real-time analysis of the battlespace environment as well as improving the global forecasting skill. - Continued development and validation of the Advanced Propagation Model to account for atmospheric effects on EM radiation, in particular, by the addition of the capability to describe high frequency radio frequencies. - Continued development of new methods, which account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Continued effort to exploit probabilistic parameter ensembles for model improvement and construct a basis for observation-informed stochastic model integration. - Continued effort to improve understanding of atmospheric physical processes in the Arctic. - Continued effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Continued the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for rapid environmental assessment. The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support. - Continued the development of global and mesoscale aerosol/radiation models that account for the						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
major sources (desert dust, sea spray, biomass burning, industrial pollution) of visibility degradation in the atmosphere and integrate with numerical weather prediction systems for an aerosol predictive capability that can support militarily relevant time and space scales. - Continued development of methods to retrieve and assimilate remotely-sensed aerosol data into aerosol prediction models. - Completed the development and validation of a next-generation TC model that can analyze, initialize, and predict TC position, structure and intensity, using a high-resolution (< 3 km) mesoscale model. The development will leverage emerging data assimilation and modeling techniques as well as observational results from the scientific community to build upon existing modeling capabilities.						
FY 2010 Plans: - Continue all efforts of FY 2009 less those noted as completed above. - Complete development of new methods, which account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Complete effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Complete the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for rapid environmental assessment. The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support. - Complete effort to exploit probabilistic parameter ensembles for model improvement and construct a basis for observation-informed stochastic model integration. - Complete effort to improve understanding of atmospheric physical processes in the Arctic. - Complete tracking analysis of small satellite calibration targets to determine atmospheric drag due to neutral density via LIDAR remote sensing.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010 less those noted as completed above. - Continue effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Complete development of new methods, that account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Complete development of an EO propagation model that accounts for the atmospheric effects of near-surface refraction, scintillation, aerosol extinction, illumination and target, background and sensor characteristics for incorporation into EO tactical decision aids and for supporting warfare systems development. - Initiate development of a next-generation coupled mesoscale model that can analyze and predict ocean-atmosphere processes at resolutions suitable for simulating coastal ocean circulations, waves, and detailed marine atmospheric boundary layer structure to extend existing modeling capabilities to tactically useful resolutions (<1 km). -Initiate development a of next generation mesoscale model that includes coupling of the physics between the ocean-land-atmosphere-ice and two-way interaction with larger scales for higher resolution local atmospheric prediction, optimal forcing of coastal ocean prediction systems, and improved representation of mesoscale affects on global predictions. -Initiate developemnt of a next-generation, higher resolution, higher altitude, coupled global numerical weather prediction model to include advanced physics, advanced numerical methods and advanced data assimilation methods, and conduct testing and validation to investigate its suitability for replacement of current prediction systems. -Develop, test and validate a next-generation TC prediction system that can analyze, initialize, and predict TC track, structure and intensity, using a high-resolution mesoscale model coupled to the ocean waves and currents. The development will include advanced data assimilation and modeling techniques as well as new methods of retrieving observations from remote sensing.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
National Oceanographic Partnership Program (Nopp)		8.201	9.089	9.085	0.000	9.085
<p>This activity focuses on US Navy investments in the NOPP. NOPP, established by the US Congress (Public Law 104-201) in Fiscal Year 1997, is a unique collaboration among 15 federal agencies involved in conducting, funding, or utilizing results of ocean research. NOPP's value to the Navy derives from the capacity of the partnership to enable and ensure multi-agency efforts where such collaboration enhances efficiency or effectiveness, and/or reduces costs. Major areas of investment by NOPP include: development of an integrated coastal ocean observation system and development of sensors, communications and data acquisition, storage and processing tools required to affect it, modernization of ocean research and observation infrastructure, and marine mammal-related research.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued marine mammal program on noise mitigation</li><li>- Continued The Partnership for Advancing Interdisciplinary Global Modeling.</li><li>- Continued Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions.</li><li>- Continued new methods for detection of fish, fish populations and mapping of fish habitat.</li><li>- Continued development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean.</li><li>- Continued marine mammal program on methods for detection and tracking of marine mammals and mapping their habitat.</li><li>- Continued and completed wireless communications for the coastal ocean.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Continue real-time forecasting system of winds, waves and surge in TCs.</li><li>- Complete The Partnership for Advancing Interdisciplinary Global Modeling.</li><li>- Complete Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete new methods for detection of fish, fish populations and mapping of fish habitat.</li><li>- Initiate effort to develop global ocean models with sufficient resolution to accurately simulate tides and internal waves to improve the fidelity of ocean prediction systems.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li></ul>						
Ocean Acoustics  This activity is dedicated to the determination of the impact of the natural ocean environment on acoustic wave phenomena in support of naval undersea warfare and underwater force protectionoperations. This activity studies underwater acoustic propagation, scattering from ocean boundaries, and ambient noise issues that impact the development and employment of acoustic systems. The Littoral Zone (LZ) has been the ocean environment of greatest interest. Aspects of this environment, that greatly impact underwater acoustic systems, are the shallow water included in the Littoral Zone, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to rapid changes of the ocean structure. The objectives of this program are met through measuring, analyzing, modeling and simulating, and exploiting ocean acoustic factors to gain advantage over potential adversaries using undersea acoustic systems. Results of this activity support acoustic sensor and system development, performance prediction, and tactical decision aids.  Increase from FY 2009 to FY 2010 reflects increased level of investment in ocean acoustics research.  FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments.</li><li>- Continued development of a TDA that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals.</li></ul>		6.956	7.450	7.025	0.000	7.025

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div>- Continued development of a validated, physics-based processing algorithm that diagnoses acoustic performance directly from oceanographic data.</div> <div>- Continued development of a set of physics-based environmental acoustic metrics to evaluate the predictions of TDAs that are used in planning asset allocation and placement of distributed Autonomous Undersea Vehicles (AUVs) in a time evolving scenario.</div> <div>- Continued development of improved performance predictions for sonar surveillance systems that utilize horizontal line arrays operating in shelf-break environments and relate horizontal-array signal gain and coherence length to the statistics and scale lengths of transverse environmental inhomogeneities.</div> <div>- Continued development of glider ocean sampling strategies to minimize acoustic detection range uncertainty for anti-submarine warfare predictions.</div> <div>- Continued development of a broadband, bistatic reverberation time-series simulator for rangedependent underwater environments.</div> <div>- Continued development of an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves.</div> <div>- Completed Rim of the Pacific 2008 (RIMPAC08) new ASW metrics to plan ASW mission and assess ASW system performance.</div> <div>FY 2010 Plans:</div> <div>- Continue all efforts of FY 2009.</div> <div>- Complete development of glider ocean sampling strategies to minimize acoustic detection range uncertainty for anti-submarine warfare predictions.</div> <div>- Complete development of a broadband, bistatic reverberation time-series simulator for rangedependent underwater environments.</div>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, unless noted as completed above.					
Physical Oceanography  The goal of this activity is to develop naval tactical uses of knowledge of the physics of the ocean within the BSE. This is achieved through the development of predictive models of the water mass structure, waves, currents, and air-sea interactions and developing measurement/observation technology. Other applications utilize knowledge of the interaction of the water column hydrodynamics and the acoustics to predict the undersea transmission characteristics and sources of uncertainty in these statistics. Utilizing knowledge of the ocean surface physics, the physical oceanography program seeks to exploit the combination of remotely sensed data, in-situ data, and adaptively sampled data to optimize predictions of ocean currents and water column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve ASW, Naval Special Warfare (NSW), Sea-Basing, and mine warfare needs.  Increase from FY 2010 to FY 2011 due to ramping up emerging physical oceanography technologies programs.  FY 2009 Accomplishments: - Continued to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems. - Continued development of mass conserving baroclinic finite element models using discontinuous Galerkin methods. - Continued to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range-dependence. - Continued the development of a data assimilative nearshore modeling capability using	11.107	10.223	11.418	0.000	11.418

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
measurements to guide hydrodynamic forecasts including data sampling strategies and model sensitivity to data. - Continued new ocean mixed-layer algorithms for generation of synthetic profiles which has led to the operational implementation of a new system Navy Ocean Sound Speed Prediction (NOSSP) system at the Naval Oceanographic Office. - Continued the integration of hyperspectral imagery into underwater autonomous vehicles and derive river environmental properties through a combination of models and observations. - Continued the development and implementation of new techniques for parameterizing fluxes of mass and energy across the air-sea interface in coupled ocean-atmosphere models, to improve operational predictions of the BSE. - Continued development and testing of acoustic communications, disposable environmental instruments, and Unmanned Undersea Vehicles (UUV) and gliders for NSW mission support. - Continued developing Delft3-D-Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) to include new options for riverine input and transport and behavior of contaminants in support of NSW mission planning. - Continued development of the knowledge layer of the internal wave tactical decision aid. - Continued development and testing of optimizing remote environmental monitoring units and other autonomous devices for NSW-Meteorological and Oceanographic Command (METOC) uses in assessing METOC conditions and providing data for assimilation. - Continued the development of synthetic aperture radar and hyperspectral imagery exploitation for NSW and Marine Expeditionary Forces as well as the support of new riverine units. - Continued studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas. - Continued to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. - Continued developments in atmospheric and ocean model NOWCAST/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area.						

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>								
				<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<ul style="list-style-type: none"> <li>- Complete effort to obtain tidal constituents in estuaries combining sequential remote sensing imagery, tide gauge data and numerical model simulations.</li> <li>- Complete effort to develop and put in place the algorithms, data processing systems, product validation, mission planning and post-processing resources to exploit the science data stream from the HICO spaceborne hyperspectral imager.</li> </ul>								
Accomplishments/Planned Programs Subtotals				47.467	48.548	49.491	0.000	49.491
<b>C. Other Program Funding Summary (\$ in Millions)</b>								
N/A								
<b>D. Acquisition Strategy</b>								
N/A								
<b>E. Performance Metrics</b>								
<p>All Science and Technology model improvements undergo a rigorous validation verification and evaluation against quantifiable metrics before being accepted for transition into operations. In Marine Meteorology, for example, typical improvements over the past decade have amounted to a gain in skill of one forecast-day (i.e., the 4-day forecast is now as skillful as the 3-day forecast of a decade ago), and tropical cyclone forecast track error has been reduced by 50%. It is expected that future increases in skill will continue at or above this pace.</p>								

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<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	4.388	5.179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	34.941
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>				
Congressional Add: Autonomous Marine Sensors and Networks for Rapid Littoral Assessment <i>FY 2009 Accomplishments:</i> This effort supported research into the development of small, low-power sensors to use on small autonomous underwater vehicles designed for clandestine rapid environmental assessment and continued development of advanced underwater sensing systems and associated systems.  <i>FY 2010 Plans:</i> Continues support of Autonomous Marine Sensors and Networks for Rapid Littoral Assessment research.						1.596	2.390				
Congressional Add: Underwater Imaging and Communications Using Lasers <i>FY 2010 Plans:</i> This effort supports Underwater Imaging and Communications Using Lasers research.						0.000	1.992				
Congressional Add: Unmanned Undersea Vehicle Submerged Long Range Positioning						0.000	0.797				

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Unmanned Undersea Vehicle Submerged Long Range Positioning research.		
Congressional Add: Extended Underwater Optical Imaging <i>FY 2009 Accomplishments:</i> This effort supported the development of future concepts designed to optically image objects underwater at ranges currently not achievable and communicate underwater with optical signals. Laboratory tank experiments were directed at optimizing the architecture of compact underwater imaging sensors and tests of optical communications concepts.	1.994	0.000
Congressional Add: Littoral Battlespace Sensing (LBS) & Autonomous Underwater Vehicle System (UAV) <i>FY 2009 Accomplishments:</i> This effort supported research into the effective utilization of Autonomous Underwater Vehicle (AUVs). The understanding of operational metrics, manpower requirements, training, and CONOPS has been increased through AUV experimentation and leveraging commercial AUV user experience. Through this research, additional knowledge has been gained relating to mission planning, data quality control, data assimilation, and shipboard communications - all critical elements of the Oceanographer of the Navy's Littoral Battlespace Sensing - Unmanned Underwater Vehicle (LBS-UUV) program.	0.798	0.000
Congressional Adds Subtotals	4.388	5.179
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		

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APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602435N: <i>Ocean Wrfghtg Env Applied Res</i>	PROJECT 9999: <i>Congressional Adds</i>
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602651M: JT Non-Lethal Wpns Applied Res							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	4.795	5.983	6.002	0.000	6.002	5.948	5.928	6.066	6.197	Continuing	Continuing
0000: JT Non-Lethal Wpns Applied Res	4.795	5.983	6.002	0.000	6.002	5.948	5.928	6.066	6.197	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

The DOD's Joint Non-Lethal Weapons Program (JNLWP) was established by the Secretary of Defense, who assigned centralized responsibility for DoD joint research and development of non-lethal technology to the Commandant of the Marine Corps as the Executive Agent. The Under Secretary of Defense for Acquisition, Technology and Logistics provides direct oversight of the JNLWP.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions provided by the Joint Non-Lethal Weapons (NLW) Integrated Product Team, a multi-service flag level corporate board that executes the JNLWP for the Commandant of the Marine Corps. This direction is based on the needs and capabilities of the Services, the Special Operations Command, and the Coast Guard, as identified in the DoD's Non-Lethal Weapons Joint Capabilities Based Assessment Document. This coordinated joint S&T development approach addresses mutual capability gaps and assures the best non-lethal technologies and equipment are provided to the operating forces while eliminating duplicative service S&T investment.

This program funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-material missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics. This program transitioned from PE 0602114N, Power Projection Applied Research by order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L), to a separate PE for Joint Non-Lethal Weapons Applied Research and established the Marine Corps as the executive agent for DoD Joint Non-Lethal Weapons RDT&E.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0602651M: JT Non-Lethal Wpns Applied Res			
BA 2: Applied Research					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	6.065	6.008	0.000	0.000	0.000
Current President's Budget	4.795	5.983	6.002	0.000	6.002
Total Adjustments	-1.270	-0.025	6.002	0.000	6.002
• Congressional General Reductions		-0.025			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		0.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-1.196	0.000			
• SBIR/STTR Transfer	-0.074	0.000			
• Program Adjustments	0.000	0.000	6.002	0.000	6.002
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602651M: <i>JT Non-Lethal Wpns Applied Res</i>				<b>PROJECT</b> 0000: <i>JT Non-Lethal Wpns Applied Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>JT Non-Lethal Wpns Applied Res</i>	4.795	5.983	6.002	0.000	6.002	5.948	5.928	6.066	6.197	Continuing	Continuing
<b>A. Mission Description and Budget Item Justification</b> This project funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and countermaterial missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
(U) JOINT NON -LETHAL WEAPONS  This project funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and countermaterial missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics.  <i>FY 2009 Accomplishments:</i> FY 2009 Accomplishments: - Continued examination of target effects/characterization and assessed the resulting crowd behavior and effectiveness of non-lethal acoustic and optical (light stun/distract) technologies.						4.795	5.983	6.002	0.000	6.002	

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602651M: JT Non-Lethal Wpns Applied Res		PROJECT 0000: JT Non-Lethal Wpns Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued investigation of the characteristics, optimization, and control of Laser Induced Plasma (LIP) phenomena for its non-lethal applications to both counter-personnel and counter-materiel missions. LIP is a phenomenon of high energy, short pulse lasers that have several potential applications to produce or transmit non-lethal stimuli.</li><li>- Continued investigation of several advanced non-lethal material technologies with non-lethal weapons applications, including engine suffocates, morphing materials for new non-lethal rounds or flight bodies, and new non-lethal nano-materials.</li><li>- Continued refinement of directed energy weapon models through research into non-lethal phenomena and assessment of human effects and weapon effectiveness.</li><li>- Continued applied research in the development of counter-personnel and counter-materiel directed energy non-lethal weapons, including counter-vehicle and advanced active denial activities.</li><li>- Continued academic research into technology areas with relevance to non-lethal weapon capabilities.</li><li>- Completed transition to higher categories of development using light and sound combinations to produce non-lethal human effects, to include saccade motion, discomfort and disability glare, flashblindness, and potential cognitive effects, with level of light/sound stimuli below hazardous levels.</li><li>- Initiated investigations of alternative technologies with potential to address emerging capability gaps.</li><li>- Initiated characterization efforts of alternative directed energy technologies by building upon the ATBM model as part of the Human Effects Modeling Analysis Program (HEAMP) to incorporate suitable sensors capable of measuring directed energy effects (millimeter - wave, high powered microwave, etc).</li><li>- Initiated investigation of candidate technologies applicable to delivering laser induced plasma effects.</li></ul> <p>Acquisition Workforce Fund:</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2009, less those noted as complete above.</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy				<b>DATE:</b> February 2010		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0602651M: <i>JT Non-Lethal Wpns Applied Res</i>		<b>PROJECT</b> 0000: <i>JT Non-Lethal Wpns Applied Res</i>		
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>						
		<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<ul style="list-style-type: none"> <li>- Complete examination of target effects/characterization and assessment of the resulting crowd behavior and effectiveness of non-lethal acoustic and optical (light stun/distract) technologies.</li> <li>- Complete investigation of several advanced non-lethal material technologies with non-lethal weapons applications, including engine suffocates, morphing materials for new non-lethal rounds or flight bodies, and new non-lethal nano-materials.</li> <li>- Complete investigation of the characteristics, optimization, and control of Laser Induced Plasma (LIP) phenomena for its non-lethal applications to both counter-personnel and counter-material missions. LIP is a phenomenon of high energy, short pulse lasers that have several potential applications to produce or transmit non-lethal stimuli.</li> <li>- Initiate human effects investigation of alternative physical phenomena to non-lethally suppress humans beyond small arms range.</li> </ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"> <li>- Continue all efforts from FY 2010, less those noted as complete above.</li> <li>- Initiate target effects characterization and assessment of resulting crowd behavior and effectiveness associated with promising alternative physical phenomena identified during FY 2010 investigations.</li> <li>- Initiate investigations of advanced materials and emergent technologies suitable for extended range non-lethal weapon payload applications.</li> <li>- Initiate transition of foundational effects associated with advanced electro-muscular disruption technologies to higher levels of technology development and demonstration.</li> </ul>						
Accomplishments/Planned Programs Subtotals		4.795	5.983	6.002	0.000	6.002
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A						
<b>D. Acquisition Strategy</b> Not applicable.						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602651M: <i>JT Non-Lethal Wpns Applied Res</i>	<b>PROJECT</b> 0000: <i>JT Non-Lethal Wpns Applied Res</i>
<b>E. Performance Metrics</b> The primary objective of this Program Element is the development of technologies that lead to the next-generation of non-Lethal Weapons. The program consists of a collection of projects that range from studies and analyses to the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602747N: Undersea Warfare Applied Res							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	61.413	65.003	69.186	0.000	69.186	89.728	97.670	97.348	100.520	Continuing	Continuing
0000: Undersea Warfare Applied Res	54.631	55.443	69.186	0.000	69.186	89.728	97.670	97.348	100.520	Continuing	Continuing
9999: Congressional Adds	6.782	9.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	44.428
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. Technologies being developed within this PE are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets. Research focused on understanding the impacts on marine mammals of manmade underwater sound is also conducted in the Program Element.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		PE 0602747N: Undersea Warfare Applied Res			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	65.187	55.694	0.000	0.000	0.000
Current President's Budget	61.413	65.003	69.186	0.000	69.186
Total Adjustments	-3.774	9.309	69.186	0.000	69.186
• Congressional General Reductions		-0.271			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.020			
• Congressional Adds		9.600			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-2.691	0.000			
• SBIR/STTR Transfer	-1.083	0.000			
• Program Adjustments	0.000	0.000	69.186	0.000	69.186
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds				FY 2009	FY 2010
Congressional Add: Autonomous UUV Delivery And Communication System Integration				0.000	3.585
Congressional Add: Advanced High Energy Density Surveillance Power Module				2.394	3.187
Congressional Add: Autonomous Unmanned Undersea Vehicle (UUV) Delivery & Communication (AUDAC) Implementation				2.792	0.000
Congressional Add: Galfenol Energy Harvesting				1.596	2.788
Congressional Add Subtotals for Project: 9999				6.782	9.560
Congressional Add Totals for all Projects				6.782	9.560
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602747N: <i>Undersea Warfare Applied Res</i>	
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602747N: <i>Undersea Warfare Applied Res</i>				<b>PROJECT</b> 0000: <i>Undersea Warfare Applied Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Undersea Warfare Applied Res</i>	54.631	55.443	69.186	0.000	69.186	89.728	97.670	97.348	100.520	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. Technologies being developed within this project are aimed at enabling Sea Shield which is one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets.

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>ANTI-SUBMARINE WARFARE (ASW) DISTRIBUTED SEARCH</b>  ASW Distributed Search focuses on the development of technologies for the non-covert tactical search for undersea targets ranging from hours to weeks using automated sensor systems deployed around operating areas including along key transit routes to protect naval/maritime forces, around temporarily fixed sea base regions and naval force operating areas, or around fixed defensive regions and areas of interest such as key US/Allied ports. "Non-covert" implies availability of airborne assets for sensor deployment (although other means may also be used), and the ability to employ active sonar along with passive and non-acoustic methods. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The submarine target must be detected beyond its weapons release range. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Distributed Search supports the ASW protected passage Maritime Shield operational constructs. Related efforts include the development of distributed systems employing optimization as well as active acoustic sensing and processing techniques, navy-unique transduction and underwater networking	0.000	12.972	14.592	0.000	14.592

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602747N: Undersea Warfare Applied Res		PROJECT 0000: Undersea Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>technology. Efforts also include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components. These efforts provide an extended reach of organic platform-based systems through the use of new sensor concepts, improved materials for advanced sensors, optimized deployment, employment, and automated operation of distributed sensor fields. The cornerstone of Distributed Search is the development of rapidly deployable, long-endurance active sensors with automated processing suitable for use in a wide variety of operational environments.</p> <p>The FY 2009-2010 funding increase is due to the realignment of the Wide Area ASW Surveillance and Battlegroup ASW Defense Activities into this new Activity.</p> <p><i>FY 2010 Plans:</i> The following efforts transferred into this activity from the FY 2009 Wide Area ASW Surveillance activity:</p> <ul style="list-style-type: none"><li>- Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts.</li><li>- Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.</li><li>- Continue development of "intelligent" algorithms aimed at optimizing distributed multistatic sources/receivers.</li><li>- Initiate research and development of feature-based tracking techniques to improve multi-sensor tracking of quiet submarines in littoral and deep-ocean environments.</li><li>- Initiate research into the characterization and classification of deep-ocean clutter sources to improve active sonar system performance in Convergence Zone (CZ) and other deep-ocean propagation conditions.</li><li>- Initiate development of Non-Traditional Transduction Methods (NTTM) which fundamentally departs from conventional ASW transduction techniques.</li><li>- Initiate development of Non-Acoustic Fiber Optic Sensors (NA-FOS) for ASW applications.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602747N: Undersea Warfare Applied Res		PROJECT 0000: Undersea Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate research aimed at adaptive design and synthesis of networked distributed sensors.</li><li>- Initiate effort to demonstrate the effectiveness of structural acoustic-based classifier techniques to detect, localize and identify.</li></ul> <p>The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:</p> <ul style="list-style-type: none"><li>- Continue an applied research effort to improve distributed system processing techniques and capabilities.</li><li>- Initiate development of high fidelity computer-based simulation training with linked architecture that supports ASW training from the operator-level to the ASW Commander-level applicable to both surface and air platforms.</li></ul> <p>The following efforts transferred into this activity from the FY 2009 Battlegroup ASW Defense activity:</p> <ul style="list-style-type: none"><li>- Continue development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification, and Localization of small, slow moving submarines in shallow water.</li><li>- Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.</li><li>- Continue design and development of underwater projectors using structural magnetostrictive materials.</li><li>- Continue dipole projector array design and development.</li><li>- Continue compact low frequency projector developments.</li><li>- Continue single crystal and hybrid projector design and development.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete dipole projector array design and development.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602747N: Undersea Warfare Applied Res		PROJECT 0000: Undersea Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue all efforts of FY 2010. - Complete an applied research effort to improve distributed system processing techniques and capabilities. Technologies will transition to Air ASW Systems, NAVAIR PMA.						
ANTI-SUBMARINE WARFARE (ASW) PERFORMANCE ASSESSMENT  The goal of this work is to integrate ocean and atmospheric environmental characteristics with sensor performance predictions in order to develop algorithms and Tactical Decision Aids (TDAs) that will accurately predict overall sensor performance in a given environment in near real-time for both present and future situations. The results of these research efforts in conjunction with embedded state-of-the- art command and operator-level training will facilitate the optimum employment of ASW sensor systems, thus increasing their effectiveness and potentially decreasing the number of sensors used to provide coverage in a given area. This work will provide operational commanders with sensor performance predictions which allow them to accurately judge the performance of those sensors, as well as information with which to deploy them for the greatest operational effect. It will also provide information as to how the performance evolves over time due to effects such as the deformation of sensor locations by currents, sound velocity profile changes, geologic magnetic interference changes, or changes to the optical properties of the water, etc. The effort includes performance predictions for fields of sensors as well as individual sensors themselves and applies to both acoustic and nonacoustic sensors.  Work includes development of ASW sensor and system performance models, and realistic simulations and measures of effectiveness that incorporate and exploit critical environmental knowledge. It includes efforts to couple ocean dynamics and acoustics, characterize ambient noise in the littorals, measure and model acoustic and optical propagation and scattering in complex environments, develop algorithms to extract environmental information from through-the-sensor measurements and quantification and prediction of uncertainty. This information is combined with the operating		0.000	4.145	3.052	0.000	3.052

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>characteristics of particular sensors (or groups of sensors) to provide predictions of sensor performance in the environment at that particular time and in the future. The predictions will also include assessments of the prediction uncertainty due to environmental measurement and sensor performance uncertainties.</p> <p>This work aligns principally with the Assure Access and Hold at Risk S&amp;T Focus Area in the Naval S&amp;T Strategic Plan and contributes measurably to the Operational Environments S&amp;T Focus Area strategic objectives.</p> <p>The FY 2009-2010 funding increase is due to the realignment of Wide Area ASW Surveillance activity into this new activity. Decrease from FY 2010 to FY 2011 is due to phasing down in funding for FNC SHD-FY09-01 (Operation of ASW Active Distributed Systems).</p> <p><i>FY 2010 Plans:</i></p> <p>The following efforts transferred to this activity from the FY 2009 Wide Area ASW Surveillance activity:</p> <ul style="list-style-type: none"><li>- Complete development of models that accurately characterize short and long range forward scattering from the ocean boundaries for surveillance through tactical sonar frequencies.</li></ul> <p>The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:</p> <ul style="list-style-type: none"><li>- Continue an applied research effort to improve distributed system processing techniques and capabilities.</li><li>- Continue research effort aimed at the ideal placement of acoustic sources and drifting sensor systems using in-situ environmental information and models.</li><li>- Continue research effort focusing on distributed system in-situational environmental characterization and system monitoring.</li><li>- Continue research effort aimed at the ideal placement and control of acoustic sources and drifting sensors systems.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue research effort to determine the placement of and follow-on control and pattern keeping of mobile sources and distributed sensor systems.</li><li>- Initiate development of algorithms to extract environmental information from through-the-sensor measurements.</li></ul> <p><i>FY 2011 Base Plans:</i> The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>						
ANTI-SUBMARINE WARFARE (ASW) PRECISION LOCALIZATION  Precision Localization focuses on the development and demonstration of technologies which use information from surveillance or search systems to determine an area of uncertainty (AOU) relative to target range, bearing, and depth adequate to handoff to an attack system. Precision Localization employs non-acoustic techniques such as magnetic and optical sensing to highly localize submerged threats. The objective is to increase magnetic sensor range and robustness, enable deployment on Unmanned Air Vehicles (UAVs), and increase optical sensing search rates. Efforts include the development of non-traditional tracking and advanced magnetic and electric field sensors and processing. These technologies will provide a decreased AOU size thus enabling the effective use of smaller, more versatile torpedoes as well as increased performance gain in detection, targeting, tracking/trailing, and homing via target acquisition and covert prosecution.  The FY 2009-2010 funding increase is due to the realignment of the Wide Area ASW Surveillance Activity into this new Activity.  <i>FY 2010 Plans:</i> The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity:		0.000	3.612	3.694	0.000	3.694

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue development of a non-traditional tracking system for deployment on undersea vehicles.</li><li>- Continue testing of a non-traditional tracking system.</li><li>- Continue development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.</li><li>- Continue an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications.</li><li>- Continue an effort to extend the technology base for high performance electro-optic detectors suitable for Undersea Warfare applications including underwater communications.</li><li>- Continue an effort to extend the technology base for high performance electro-optic filters suitable for Undersea Warfare applications including underwater communications.</li><li>- Continue an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems.</li><li>- Continue an effort to develop optical signal processing and hybrid computing technology appropriate for Undersea Warfare and underwater communications systems.</li><li>- Complete development of spin-dependent tunneling and coupled magnetostrictive/piezoelectric passive magnetometer device technologies.</li><li>- Initiate development of ASW sensor technologies capable of being deployed by a gun or missile launcher.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li></ul>					
ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	0.000	15.084	26.232	0.000	26.232
ASW Surveillance focuses on dramatically improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of legacy ASW surveillance systems. The related technologies support the conduct of covert wide-area surveillance ranging from one day to six months. The objectives are to develop and demonstrate technologies that provide clandestine indications and warnings in far forward and contested operating areas and in complex operational					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
environments against all submarine threats including new threats with unknown target signatures and tactics. Covertiness implies use of non-observable platforms and/or deployed automated sensors employing passive sonar or other non-detectable methods. The surveillance process includes initial detection and classification. Efforts include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing a wide variety of surveillance concepts and components. These efforts focus on alternative detection phenomena, vector/tensor sensors, automated acoustic processing, more compact and longer lasting power sources, and high bandwidth acoustic communications links.						
The FY 2009-2010 funding increase is due to the realignment of the Wide Area ASW Surveillance and Battlegroup ASW Defense activities into this new activity. Increase from FY 2010 to FY 2011 is due to new FNC (SHD-FY10-05 Affordable Vector Sensor Towed Array and Signal Processing) starting in FY 2011.						
FY 2010 Plans: The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales. - Complete design of a "Sea Star" undersea local area network to link peripheral sensors to a centralized node through high-bandwidth, short-haul acoustic communications. - Complete fiber optic technology development to support the next generation of submarine hull arrays including new transducers, optical multiplexing, and optical components. - Initiate development of Non-Acoustic Underwater Communications. - Initiate development of Advanced Imaging Methods (AIM) to provide expanded spatial, temporal and spectral imaging options. - Initiate an effort to research improved seawater electrodes for Underwater Electric Potential (UEP) sensing in ASW applications.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate research the goal of which is to form underwater magnetic sensors into a virtual gradiometric array via non-cabled communications.</p> <p>The following Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity:</p> <ul style="list-style-type: none"><li>- Continue development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL).</li><li>- Initiate development of a vector sensor towed array and associated signal processing with performance nominally equivalent to a "thin-line" (TB-29) twin-line towed array to be compatible with the existing TB-29 array handling system.</li></ul> <p>The following efforts were transferred to this new activity from the FY 2009 Battlegroup ASW Defense activity:</p> <ul style="list-style-type: none"><li>- Continue development of an acoustic/magnetic hybrid sensor.</li><li>- Continue development of low cost, compact, combined acoustic sensor.</li><li>- Continue electroactive polymer smart sensor development.</li><li>- Continue research to improve detection of quiet diesel-electric submarines using passive sonar arrays in deep ocean environments.</li><li>- Complete development of target classification algorithms that adapt to local shipping noise conditions, thereby reducing false alarm probability.</li><li>- Complete development of environmentally adaptive target detection and classification algorithms for deep water operating environments.</li><li>- Initiate research to predict performance of automated passive sonar detection and classification algorithms in shallow and deep ocean environments.</li><li>- Initiate biomimetic and nano sensor development.</li><li>- Initiate 'hockey puck' transducer/amplifier module development.</li><li>- Initiate broadband, directional, high power array development.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Complete development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales.  The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue all efforts of FY 2010, less those noted as completed above.						
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE  Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target gray ships. This technology area is primarily concerned with detections inside 10 nautical miles. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. Research aimed at understanding and predicting the impacts of manmade underwater sound on marine mammals is also conducted in this activity. Battlegroup ASW Defense will enable smaller, lighter, and cheaper acoustic/non-acoustic arrays, large multi-line arrays, and submarine flank arrays (all with environmental adaptation capabilities).  The FY 2009 to FY 2010 funding decrease is due to the realignment of this Activity to the newly established ASW Distributed Search and Surveillance Activities in FY 2010.  FY 2009 Accomplishments: - Continued an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet ASW experimentation exercises and		9.979	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
demonstrations when sound is transmitted underwater. This effort transfers to the newly established Marine Mammals Activity in FY 2009. - Continued development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification, and Localization of small, slow moving submarines in shallow water. - Continued design and development of underwater projectors using structural magnetostrictive materials. - Continued development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features. - Continued dipole projector array design and development. - Continued compact low frequency projector developments. - Initiated single crystal and hybrid projector design and development. The above efforts transfer to the new ASW Distributed Search activity in FY 2010.  - Continued development of an acoustic/magnetic hybrid sensor. - Continued development of low cost, compact, combined acoustic sensor. - Continued electroactive polymer smart sensor development. - Continued development of target classification algorithms that adapt to local shipping noise conditions, thereby reducing false alarm probability. - Continued development of environmentally adaptive target detection and classification algorithms for deep water operating environments. - Initiated research to improve detection of quiet diesel-electric submarines using passive sonar arrays in deep ocean environments. The above efforts transfer to the new ASW Surveillance activity in FY 2010.					
MARINE MAMMALS  The goal of this activity is to support: (1) marine mammal research related to understanding impacts of underwater sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions	4.202	5.030	5.205	0.000	5.205

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; (3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine organisms; and (4) research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing of bioluminescence sensors).						
The marine mammals research conducted in this Program Element (P.E.) represents part of a total effort executed in coordination with complementary research performed in P.E. 0602435N.						
This Activity has been created specifically to address the work associated with determining and mitigating the effects on the behavior of marine mammals of manmade sound transmitted underwater.						
FY 2009 funding is associated with this newly created Activity which was funded from the Battlegroup Anti-Submarine Warfare Activity and the Wide Area Anti-Submarine Warfare Surveillance Activity.						
FY 2009 Accomplishments: - Completed an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet Anti-Submarine Warfare experimentation exercises and demonstrations when sound is transmitted underwater. This effort transferred to this newly established Activity from the Battlegroup Anti-Submarine Warfare Defense Activity. - Initiated multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures. - Initiated development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery. - Initiated research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts).						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
technology enablers (where possible), to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, and enable new undersea weapon concepts of operations to rapidly transition to submarine neutralization/engagement in deep and shallow water under unique payload limitations posed by unmanned platforms, external stowage, and future Naval platforms.						
The following demonstration FNC projects are included in this activity: 1) the Lightweight Torpedo Technology (LTT) project (transitions to PE 0603747N in FY 2009), and 2) the Compact Rapid Attack Weapon (CRAW) project.						
The FY 2009 to FY 2010 funding decrease is due to the realignment of the Neutralization activity to the newly established Undersea Weaponry activity in FY 2010.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons (examine experimentally, in water, the physics of interactions among multiple supercavitating projectiles in a projectile burst).</li><li>- Continued optimization of undersea weapons system design using MSDO with respect to constraints in cost and performance.</li><li>- Continued effort to conduct full ship validation effort for Explosion Response simulation code, using Dynamic System Mechanics Advanced Simulation (DYSMAS) Hydrocode (test plan developed, finite element ship model was completed, pretest simulations were conducted).</li><li>- Continued implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.</li><li>- Continued development of high-speed supercavitating torpedo vehicle control and homing sensor.</li><li>- Continued to conduct experiments and tests on vehicle control concepts and homing sensors.</li><li>- Continued fourth quarter (of the fiscal year) explosive testing for warhead projects.</li><li>- Continued conduct of computer code refinements and investigation of supercavitating vehicle dynamics and instability.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of a supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and homing sensors.</li><li>- Continued feasibility investigations (including acoustic element construction) to test the ability of single crystal to operate at high field, high drive, and high duty cycle for both torpedo Tonpiltz transducer and broadband cylindrical projector applications.</li><li>- Continued fin and cavitator control, and integrate with controller for the supercavitating 6.75-inch vehicle.</li><li>- Continued torpedo design and optimization to support the external weapon stowage effort in DARPA Tango Bravo Program.</li><li>- Continued data collection on a technology test-bed for surface ship close in torpedo defensive system using supercavitating projectiles.</li><li>- Continued efforts in electric propulsion for the Next Generation Torpedo.</li><li>- Continued signal processing and homing algorithms for supercavitating vehicle.</li><li>- Continued efforts that enhance undersea weapons Guidance and Control (G&amp;C) capabilities in autonomy, sensors, sensor processing, communication and networking by leveraging current, or contribute to developing, technologies for UUVs.</li><li>- Continued weaponization study for unmanned undersea vehicle initiated.</li><li>- Continued test and evaluation of signal processing and homing algorithms for supercavitating vehicle.</li><li>- Continued integration of hydroreactive shaped charge technology into CRAW warhead development. (Technology transitioning from PE 0602123N)</li><li>- Continued long pulse concept to exploit explosion bubble technology to enhance undersea warhead performance with smaller volumetric requirements.</li><li>- Continued efforts to develop air and underwater delivered kinetic energy enhanced lethality warhead concepts.</li><li>- Continued hybrid propulsion for Heavyweight Torpedo.</li><li>- Continued weaponization study for unmanned surface vehicle.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed transition of appropriate supercavitating vehicle control technology and devices to DARPA Underwater Express Program.</li><li>- Completed efforts in electric propulsion for LWT.</li><li>- Completed signal processing and homing algorithms for supercavitating vehicle.</li><li>- Completed the evaluation of the integration of hydroreactive shaped charge technology into CRAW warhead development.</li><li>- Completed weaponization study for unmanned undersea vehicle.</li><li>- Initiated development of advanced undersea warhead fuzing concepts.</li><li>- Initiated quiet propulsion systems development for torpedoes.</li><li>- Initiated and completed development of enhanced yield explosive concepts for undersea warhead applications.</li></ul> <p>The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:</p> <ul style="list-style-type: none"><li>- Continued application of MSDO tools probabilistic methods and uncertainty analysis for LWT design.</li><li>- Continued development of enhanced performance for torpedo warheads through the use of focused energy technologies for Light Weight Torpedo (LWT) Improvement and CRAW applications.</li><li>- Continued development of a reduced size/weight CRAW for air deployment. This effort included sensor, guidance and control, warhead, propulsion, and air frame integration tasks.</li><li>- Continued technology to enable a CRAW warhead to achieve required lethality against submarine targets.</li><li>- Continued use of design techniques for LWT using undersea weapons system design tools transitioned from Discovery and Innovation to FNC.</li><li>- Continued development of a shaped charge liner for CRAW warhead.</li><li>- Continued an iterative algorithm development to enable the CRAW to search, home, and terminally home against targets in deep and shallow water both without and with countermeasures.</li></ul>						
UNDERSEA WEAPONRY		0.000	14.600	16.411	0.000	16.411

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		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
This is a new R-2 Activity starting in FY10. Efforts in this R-2 Activity were funded in the Neutralization R-2 Activity prior to FY10.						
Undersea Weaponry focuses on the development of enabling technologies to counter threat submarines and surface vessels by increasing Probability of Kill and platform survivability. Weapon technology focus areas include: Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing, and Propulsion), Power Sources, Supercavitation, and Counter Weapons/Counter Measures.						
The ultimate goal of this activity is to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, to accommodate unique payload limitations through the development of modular and reduced sized undersea weapons based on common technology enablers (where possible), and to provide improved submarine wide area search/cuing in deep and shallow water ocean environments while providing the capability to rapidly adapt the submarine mission to engagement/neutralization.						
The FY 2009 to FY 2010 funding increase is due to the realignment from the Neutralization activity to this newly established Undersea Weaponry activity in FY 2010. Increase from FY 2010 to FY 2011 is due to new FNC (SHD-FY11-01 Torpedo Common Hybrid Fuzing System) starting in FY 2011.						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Complete evaluation of alternative undersea warhead fuzing concept developed under the advanced undersea warhead fuzing initiative.</li><li>- Complete weaponization study for unmanned surface vehicle.</li><li>- Complete assessment of the kinetic energy warhead concept potential to provide enhanced undersea warhead performance.</li><li>- Complete transition of the Torpedo Intelligent Controller to NAVSEA/PMS 404.</li></ul>						

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	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:</p> <ul style="list-style-type: none"><li>- Continue development of a reduced size/weight CRAW for air deployment. This effort will include sensor, guidance and control, warhead, propulsion, and air frame integration tasks.</li><li>- Continue the development of algorithms for CRAW to search, home and terminally home in deep and shallow water against targets both without and with countermeasures.</li><li>- Continue the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal.</li><li>- Complete development of enhanced performance concept for torpedo warheads using focused energy technologies for Light Weight Torpedo (LWT) Improvement and CRAW applications.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Complete assessment of the kinetic energy warhead concept potential to provide enhanced undersea warhead performance.</li><li>- Complete a proof-of-concept demonstration of optical fuzing components developed under the advanced undersea warhead fuzing initiative.</li><li>- Complete development of the supercavitating 6.75-inch vehicle with vehicle control devices and homing sensors.</li><li>- Complete assessment of the long pulse concept potential to provide enhanced undersea warhead performance with smaller volumetric requirements.</li></ul> <p>The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li></ul>					
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	24.717	0.000	0.000	0.000	0.000
Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable offboard systems with associated processing and robust, high bandwidth communications links. The cornerstone of Wide Area Surveillance is the ability to rapidly distribute acoustic and non-acoustic					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>sensors from air, surface, and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked-components, multi-static operation, and supported by passive/active signal processing all with the objective of increased detection capabilities.</p> <p>FY 2009 funds were moved to the newly established Marine Mammals Activity (\$1.2M). The FY 2009 to FY 2010 funding decrease is due to the realignment of this activity to the newly established ASW Distributed Search, Performance Assessment, Precision Localization and Surveillance activities in FY 2010.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts.</li><li>- Continued development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.</li><li>- Continued development of "intelligent" algorithms aimed at optimizing distributed multistatic sources/receivers.</li><li>- Initiated a research effort to accomplish array shape estimation using fiber-optic interferometric methods.</li><li>- Initiated a collaborative follow-on Joint Research Project for Next Generation Autonomous Sensing (NGAS).</li></ul> <p>The above efforts transfer to the new ASW Distributed Search activity in FY 2010.</p> <p>- Continued development of a non-traditional tracking system for deployment on undersea vehicles.</p> <p>- Continued testing of a non-traditional tracking system.</p> <p>- Continued development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications.</li><li>- Continued an effort to extend the technology base for high performance electro-optic detectors suitable for Undersea Warfare applications including underwater communications.</li><li>- Continued an effort to extend the technology base for high performance electro-optic filters suitable for Undersea Warfare applications including underwater communications.</li><li>- Continued an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems.</li><li>- Continued an effort to develop optical signal processing technology appropriate for Undersea Warfare and underwater communications systems.</li><li>- Continued development of spin-dependent tunneling and coupled magnetostrictive/piezoelectric passive magnetometer device technologies.</li></ul> <p>The above efforts transfer to the new ASW Precision Localization activity in FY 2010.</p>						
<ul style="list-style-type: none"><li>- Continued development of models that accurately characterize short and long range forward scattering from the ocean boundaries for surveillance through tactical sonar frequencies.</li></ul> <p>The above effort transfers to the new ASW Performance Assessment activity in FY 2010.</p>						
<ul style="list-style-type: none"><li>- Continued design of a "Sea Star" undersea local area network to link peripheral sensors to a centralized node through high-bandwidth, short-haul acoustic communications.</li><li>- Continued development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales.</li><li>- Continued fiber optic technology development to support the next generation of submarine hull arrays including new transducers, optical multiplexing, and optical components.</li><li>- Completed development of technologies for a low source-level, light-weight ship-protection system against underwater intruders, including vessels with explosives.</li><li>- Completed development of signal processing algorithms for operational and pipeline ASW active sonar systems by extending Navy's broadband, beam-based theory for the Time Reversal Operator.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602747N: Undersea Warfare Applied Res		PROJECT 0000: Undersea Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The above efforts transfer to the new ASW Surveillance activity in FY 2010.						
The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continued an applied research effort to improve distributed system processing techniques and capabilities. The above effort transfers to the new ASW Distributed Search activity in FY 2010.						
- Initiated research effort aimed at the ideal placement and control of acoustic sources and drifting sensor systems. - Initiated a research effort focusing on distributed system in-situational environmental characterization and system monitoring. - Initiated a research effort to determine the placement of and follow-on control and pattern keeping of mobile sources and distributed sensor systems. The above efforts transfer to the new ASW Performance Assessment activity in FY 2010.						
- Continued development of algorithms to optimize the placement of uncontrolled drifting systems. - Continued development of a simulator for placement of uncontrolled drifting systems. - Initiated algorithm testing of uncontrolled drifting systems using a simulator. The above efforts transfer to and continue in PE 0603747N under the new ASW Performance Assessment activity in FY 2010.						
- Continued development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL). The above effort transfers to the new ASW Surveillance activity in FY 2010.						
- Completed incorporation and enhancement of technology from real-time data fusion technologies into Distributed System Processing (DSP).						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy							<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>			<b>R-1 ITEM NOMENCLATURE</b> PE 0602747N: <i>Undersea Warfare Applied Res</i>			<b>PROJECT</b> 0000: <i>Undersea Warfare Applied Res</i>					
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<p>The above effort completes; it does not transfer or continue in FY 2010.</p> <ul style="list-style-type: none"> <li>- Completed development of automatic signal processing algorithms for use with a DWADS for surveillance of deep ocean submarine threats.</li> <li>- Completed development of a transmit/receive array for use with DWADS for surveillance of deep ocean submarine threats.</li> </ul> <p>The above efforts complete, and the project transition.</p> <p>Acquisition Workforce Fund:</p> <ul style="list-style-type: none"> <li>- Funded DoD Acquisition Workforce Fund.</li> </ul>											
Accomplishments/Planned Programs Subtotals						54.631	55.443	69.186	0.000	69.186	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0603747N: <i>UNDERSEA WARFARE ADVANCED TECHNOLOGY</i>	20.065	22.995	22.609	0.000	22.609	17.051	21.949	21.113	10.501	0.000	136.283
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> The overall metrics of applied research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602747N: <i>Undersea Warfare Applied Res</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	6.782	9.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	44.428
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Autonomous UUV Delivery And Communication System Integration <i>FY 2010 Plans:</i> This effort supports Autonomous UUV Delivery and Communication System Integration research.							0.000	3.585			
Congressional Add: Advanced High Energy Density Surveillance Power Module <i>FY 2009 Accomplishments:</i> This effort supported the development of an affordably manufacturable, high energy density battery design in a standard D-cell form factor (Other standard sizes are feasible). <i>FY 2010 Plans:</i> Continue the effort to support Advanced High Energy Density Surveillance Power Module research.							2.394	3.187			
Congressional Add: Autonomous Unmanned Undersea Vehicle (UUV) Delivery & Communication (AUDAC) Implementation							2.792	0.000			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602747N: <i>Undersea Warfare Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported increased ability for a large unmanned undersea vehicle to carry, deploy, and recover smaller UUV as described in the US Navy UUV Master Plan.		
Congressional Add: Galfenol Energy Harvesting  <i>FY 2009 Accomplishments:</i> This effort supported the development of Galfenol (Iron Gallium) alloys for use in energy harvesting devices. Developed processing techniques for texture development in rolled sheet, improvements in directional solidification practices and welding/joining studies.  <i>FY 2010 Plans:</i> Continue the effort to support Galfenol Energy Harvesting research.	1.596	2.788
Congressional Adds Subtotals	6.782	9.560
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	53.055	43.897	36.833	0.000	36.833	37.836	44.589	51.474	59.179	Continuing	Continuing
0000: Mine & Exp Warfare Applied Res	46.074	40.710	36.833	0.000	36.833	37.836	44.589	51.474	59.179	Continuing	Continuing
9999: Congressional Adds	6.981	3.187	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	30.942
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This PE provides technologies for Naval Mine Countermeasures (MCM), Expeditionary Warfare, U.S. Naval sea mining, Naval Special Warfare (NSW), and Joint Tri-Service Explosive Ordnance Disposal (EOD). This program is strongly aligned with the Joint Chiefs of Staff Joint Warfighting Capability Objectives through the development of technologies to achieve military objectives with minimal casualties and collateral damage. Within the Naval Transformation Roadmap, this investment will achieve one of three "key transformational capabilities" required by "Sea Shield" as well as technically enable the Ship to Objective Maneuver (STOM) key transformational capability within "Sea Strike" by focusing on technologies that will provide the Naval Force with the capability to dominate the battlespace, project power from the sea, and support forces ashore with particular emphasis on rapid MCM operations. These efforts concentrate on the development and transition of technologies for the MCM-related and Urban Asymmetric/Expeditionary Warfare Operations (UAEO)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). The Mine and Obstacle Detection/Neutralization efforts include technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting and neutralization/breaching. The Urban Asymmetric Operation effort includes critical warfighting functions such as Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, etc. The Naval Special Warfare and Explosive Ordnance Disposal technology efforts concentrate on the development of technologies for safe near-shore mine detection, diver mobility and survivability, and ordnance disposal operations.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		PE 0602782N: Mine & Exp Warfare Applied Res			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	54.689	40.880	0.000	0.000	0.000
Current President's Budget	53.055	43.897	36.833	0.000	36.833
Total Adjustments	-1.634	3.017	36.833	0.000	36.833
• Congressional General Reductions		-0.183			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		3.200			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-0.843	0.000			
• SBIR/STTR Transfer	-0.791	0.000			
• Program Adjustments	0.000	0.000	36.833	0.000	36.833
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds				FY 2009	FY 2010
Congressional Add: Electromagnetic Signatures Assessment System Using Multiple Autonomous Undersea Vehicles, Phase III				1.596	1.992
Congressional Add: Virtual Onboard Analyst For Multi-Sensor Mine Detection				0.997	1.195
Congressional Add: Detection and Neutralization of Electronically Initiated Improved Explosive Devices (IEDs)				1.995	0.000
Congressional Add: Water Security Program (Inland Water Quality and Desalination)				2.393	0.000
Congressional Add Subtotals for Project: 9999				6.981	3.187
Congressional Add Totals for all Projects				6.981	3.187
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>	
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>				<b>PROJECT</b> 0000: <i>Mine &amp; Exp Warfare Applied Res</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
0000: <i>Mine &amp; Exp Warfare Applied Res</i>	46.074	40.710	36.833	0.000	36.833	37.836	44.589	51.474	59.179	Continuing	Continuing
<b>A. Mission Description and Budget Item Justification</b> This project focuses on reducing the time involved in conducting MCM operations and increasing safe standoff from minefields. It develops and transitions technologies for MCM-related and UAEO-related FNC ECs. The MCM effort includes technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The Littoral Warfare effort includes critical warfighting functions such as C4ISR, fires, maneuver, sustainment, etc. The sea mining effort emphasizes technologies for future sea mines. The Naval Special Warfare and Explosive Ordnance technology efforts concentrate on the development of technologies to enhance diver capabilities including: safe near-shore mine sensing, mobility and survivability, and ordnance disposal operations.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
MINE TECHNOLOGY  This activity assesses advanced sea mine technologies to maintain expertise in this Naval Warfare area. An acoustic sensing capability for the naval mine Target Detection Device (TDD) is being addressed. Future mine and minefield concepts are being addressed.  <i>FY 2009 Accomplishments:</i> - Continued assessment of sea mine technologies in order to maintain a level of expertise in naval mines. - Initiated evaluation of an acoustic sensing capability for the naval mine Target Detection Device (TDD).  <i>FY 2010 Plans:</i> - Continue all efforts of FY 2009.							0.184	0.288	0.330	0.000	0.330

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate development of concepts for semi-autonomous and remote controlled mines and minefields.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete evaluation of an acoustic sensing capability for the naval mine Target Detection Device (TDD).</li><li>- Initiate development of target discrimination technology for Target Detection Device (TDD).</li></ul>					
MINE/OBSTACLE DETECTION	31.495	29.363	25.684	0.000	25.684
<p>This activity focuses on applied research to enable longer detection ranges and precise mine location with fewer false alarms in a variety of challenging environments. It supports Discovery and Invention (D&amp;I) and MCM-related FNC ECs. Efforts in Synthetic Aperture Sonar (SAS) technologies for longer range detection and classification of mine-like targets and magnetic gradiometer sensing and electro-optic (EO) technology for buried mine identification, and sensor integration onto Autonomous Underwater Vehicles (AUVs) are being addressed. EO sensor research develops algorithms to enable image processing for rapid overt reconnaissance from an Unmanned Aerial Vehicle (UAV). Other processing, classification and data fusion techniques to reduce operator workload, and a mine burial prediction "expert system" are also being developed. Efforts also support development of MCM Mission Modules for Littoral Combat Ships (LCS).</p> <p>The investment reduction in FY 2011 reflects the completion and transition of major FNC and D&amp;I programs/projects during FY 2011.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued at-sea testing of prototype Low Frequency Broadband (LFBB) acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments.</li></ul>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of automatic mine detection and classification algorithms for integrated forward-looking iPUMA sonar and side-looking sonars.</li><li>- Continued development of multi-platform fusion of data from high-resolution mine hunting systems (e.g. AN/AQS-20 and submarine-launched Mine warfare (MIW) Unmanned Underwater Vehicles (UUVs) via registration with those from the Mine Warfare Environmental Data Library (MEDAL) for improved mine detection and avoidance.</li><li>- Continued development of UUV-based extended range electro-optic identification sensors and supporting meteorology and oceanography and planning systems.</li><li>- Continued large area search and survey based upon multiple, cooperating UUVs.</li><li>- Continued technology development for a Tactical UAV (TUAV) buried minefield detection sensor.</li><li>- Continued technology development for MCM Mission Module systems for Advanced Flight LCS.</li><li>- Continued demonstration of flapping fin propulsion on an inexpensive, stealthy undersea vehicle to enable new mine warfare mission capabilities.</li><li>- Continued development of an ultrafast silicon carbide (SiC) avalanche transistor and a SiC drift step recovery diode.</li><li>- Continued development of Multiple Input Multiple Output (MIMO) UUV communications by determining channel capacity and extending use to moving platforms.</li><li>- Continued integration of iPUMA and SAS systems in a single vehicle to obtain 100% area coverage.</li><li>- Continued to investigate and develop signal processing algorithms in areas of research such as environmentally adaptive channel estimation/equalization, multi-carrier modulation techniques, and spatial diversity exploitation to enable reliable, high-rate communication between fixed and/or mobile nodes in an ad hoc underwater acoustic communication network.</li><li>- Completed development of algorithms exploiting broadband acoustic transmit waveforms for improved automatic classification of buried mines from clutter.</li><li>- Completed development of data fusion algorithms for underwater electro-optic, magnetic and acoustic sensors to enhance probability of classification (Pc) and probability of identification (Pid) and reduce false alarm rate for proud and buried mine hunting.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res	
B. Accomplishments/Planned Program (\$ in Millions)					
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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated research to extend electro-optical imaging resolution in underwater environments by using short exposure techniques.</li></ul> <p>Acquisition Workforce Fund:</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete technology development for a Tactical UAV (TUAV) buried minefield detection sensor.</li><li>- Complete development of advanced 3-D LIDAR mine detection algorithms to support post mission analysis.</li><li>- Complete development of the Performance Analysis and Training Tool (PATT) to assess the performance characteristics of high frequency imaging sonars and the associated sonar processing concepts.</li><li>- Complete investigation of Finite Element Modeling (FEM) for estimating the performance of the Low Frequency Broadband (LFBB) Buried Mine Identification System over a wide range of tactically important environments.</li><li>- Complete technology development for MCM Mission Module systems for Advanced Flight LCS.</li><li>- Initiate development of iPUMA/Synthetic Aperture Sonar system to provide the first non marine mammal based mine detection and classification capability for confined or highly obstructed areas.</li><li>- Initiate development of Small Acoustic Color/Imaging Sonar system to provide the first non marine mammal detection, classification and identification capability for very shallow water (VSW) and reduce the false-alarm rate by x20 for all VSW mine threats.</li><li>- Initiate development of Long Range Low Frequency Broadband (LRLFBB) Sonar to significantly increase the minehunting area coverage rate.</li><li>- Initiate development of a high source level, single crystal based projector that can extend the maximum detection range of the Low Frequency Broadband (LFBB) Mine Identification System.</li><li>- Initiate Phase 2 of Advanced Mission Module Technology Development.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate performance evaluation of physical layer signal processing algorithms and signaling schemes developed for underwater acoustic communication networks.</li><li>- Initiate implementation of candidate physical layer algorithms and signaling schemes into acoustic modems targeted for UUV platforms.</li><li>- Initiate investigation into cross-layer and/or network layer design strategies for ad hoc underwater acoustic communication networks comprised of fixed and/or mobile nodes.</li><li>- Initiate development of technologies for detection of mines and obstacles in riverine environments.</li><li>- Initiate development of mine burial prediction models which include migrating sandwaves.</li><li>- Initiate development of prediction models for surf zone optical properties.</li><li>- Initiate effort to quantify and validate improvements in probability of detection and the reduction of false alarms that can be achieved through multi-static acoustic sensing and processing for cooperating, unmanned vehicles.</li><li>- Initiate development of new waveforms and algorithms for improved automatic discrimination of mines from non-traditional clutter.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Continue development of automatic mine detection and classification algorithms for integrated forward-looking iPUMA sonar and side-looking sonars.</li><li>- Continue research to extend electro-optical imaging resolution in underwater environments by using short exposure techniques.</li><li>- Complete large area search and survey based upon multiple, cooperating UUVs and USVs.</li><li>- Complete Phase 2 of Advanced Mission Module Technology Development with a final demonstration.</li><li>- Complete development of multi-platform fusion of data from high-resolution mine hunting systems (e.g. AN/AQS-20) and submarine-launched Mine Warfare (MIW) UUVs via registration with those from the Mine Warfare Environmental Data Library (MEDAL) for improved mine detection and avoidance.</li><li>- Complete performance evaluation of physical layer signal processing algorithms and signaling schemes developed for underwater acoustic communication networks.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete development of Multiple Input Multiple Output (MIMO) UUV communications by determining channel capacity and extending use to moving platforms.</li><li>- Complete demonstration of flapping fin propulsion on an inexpensive, stealthy undersea vehicle to enable new mine warfare mission capabilities.</li><li>- Complete development of an ultrafast silicon carbide (SiC) avalanche transistor and a SiC drift step recovery diode.</li><li>- Complete at sea prototype Low Frequency Broadband (LFBB) acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments.</li><li>- Initiate development of system concepts for wide area detection of surface and submerged drifting mines.</li></ul>						
MINE/OBSTACLE NEUTRALIZATION		4.207	1.308	0.801	0.000	0.801
<p>Activity includes applied research to support selected MCM related FNC ECs for rapid mine and obstacle neutralization and sea mine jamming techniques to increase surface ship safe standoff from threat mines. It includes various lethality, vulnerability and dispensing computational tools, models and assessments to support the various far-term Surf Zone (SZ) and Beach Zone (BZ) mine and obstacle breaching concepts.</p> <p>In FY 2009, funding programmed for new FNC ECs was realigned to reflect the priorities of the Navy. The investment reduction from FY 2009 through FY 2010 reflects the completion and transfer of many major projects by the end of FY 2009 and 2010.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued technology development for autonomous neutralization of sea mines in VSW areas.</li><li>- Continued development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking.</li><li>- Continued development of AUV technologies for neutralization of littoral sea mines.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued acoustic organic mine jamming investigations as a follow-on to FNC work in electromagnetic organic mine jamming.</li><li>- Completed development of models to assess performance of bombs against mines in VSW.</li><li>- Completed development of advanced computational models for high speed water entry and penetration.</li><li>- Completed development of advanced computational tools for predicting soil penetration by countermine darts.</li><li>- Completed assessment of stand-off, assault breaching warhead fuse to extend effectiveness of unitary warheads to greater water depths.</li><li>- Initiated development of prototype mission planner for JDAM Assault Breaching System (JABS) in the VSW.</li><li>- Initiated review of GPS augmentation data collected during end-to-end tests with Amphibious Assault Vehicle (AAV) and airborne platform with mine detection sensor.</li><li>- Initiated review of data collected during AAV testing with augmented reality.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete acoustic organic mine jamming investigations as a follow-on to FNC work in electromagnetic organic mine jamming.</li><li>- Complete development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking.</li><li>- Complete development of prototype mission planner for JABS in the VSW.</li><li>- Complete review of data collected during AAV testing with augmented reality.</li><li>- Complete review of GPS augmentation data collected during end-to-end tests with AAV and airborne platform with mine detection sensor.</li><li>- Complete technology development for autonomous neutralization of sea mines in VSW areas.</li><li>- Initiate development of concepts for sweeping and/or jamming of advanced mine threats.</li><li>- Initiate a project to study feasibility of mine jamming from autonomous undersea vehicles.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div>- Initiate development of autonomous behaviors to improve neutralization efficiency of littoral sea mines.</div> <div>- Initiate development of system concepts for autonomous neutralization of surface and submerged drifting mines.</div> <div>FY 2011 Base Plans:</div> <div>- Continue all efforts of FY 2010, less those noted as completed above.</div> <div>- Complete development of AUV technologies for neutralization of littoral sea mines.</div> <div>- Complete development of autonomous behaviors to improve neutralization efficiency of littoral sea mines.</div> <div>- Initiate demonstration of autonomous neutralization of littoral sea mines.</div> <div>- Initiate a project to study system concepts for autonomous neutralization of surface and submerged drifting mines.</div>					
<div>SPECIAL WARFARE/EOD</div> <div>The goal of this effort is to develop technologies to extend stand-off of special operations and EOD forces in clandestine hydrography, mine clearance and port security missions while increasing the range and effectiveness of divers. Advanced technologies are needed to gain access to areas contaminated by area-denial sensors and/or booby traps. Developed technologies will transition to the Joint Service EOD Program, the Naval EOD Program, or the DOD Technical Response Group. This activity includes applied research in sensor technology for NSW and EOD autonomous and handheld sonar systems to increase detection range and accuracy in harsh environments. Other efforts include mission support technology improvements for AUVs and human divers - such as communications, navigation and life support.</div> <div>FY 2009 Accomplishments:</div> <div>- Continued development of AUV technologies for autonomous inspection of ship hulls.</div>	10.188	9.751	10.018	0.000	10.018

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602782N: Mine & Exp Warfare Applied Res		PROJECT 0000: Mine & Exp Warfare Applied Res		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of low probability of intercept/low probability of detection (LPI/LPD) underwater communications.</li><li>- Continued development of metal-hydride based thermal control technology for combat divers.</li><li>- Continued development of technology to detect, monitor, and disrupt operation of Explosive Safe and Arming (ESA) devices.</li><li>- Continued design of an underwater riverine autonomous surveillance system that uses multiple small sensor nodes to provide persistent surveillance.</li><li>- Continued development of tactile-feedback robotic manipulators.</li><li>- Continued development of technologies for portable hand-held detection of concealed Improvised Explosive Devices (IEDs).</li><li>- Completed development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects.</li><li>- Completed development of buried ordnance identification sensor.</li><li>- Completed assessment of x-ray fluorescence technologies for the detection of bulk explosive compounds in containers and vehicles.</li><li>- Initiated development of low collateral damage neutralization device.</li><li>- Initiated development of technologies for the detection and disruption of passive and active IR sensors.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete design of an underwater riverine autonomous surveillance system that uses multiple small sensor nodes to provide persistent surveillance.</li><li>- Complete development of low probability of intercept/low probability of detection (LPI/LPD) underwater communications</li><li>- Complete development of metal-hydride based thermal control technology for combat divers.</li><li>- Complete development of tactile-feedback robotic manipulators.</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy						<b>DATE:</b> February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>			<b>R-1 ITEM NOMENCLATURE</b> PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>			<b>PROJECT</b> 0000: <i>Mine &amp; Exp Warfare Applied Res</i>					
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<ul style="list-style-type: none"> <li>- Complete development of technologies for portable hand-held detection of concealed Improvised Explosive Devices (IEDs).</li> <li>- Complete development of technology to detect, monitor, and disrupt operation of Explosive Safe and Arming (ESA) devices.</li> <li>- Initiate development of maritime TTL technologies.</li> <li>- Initiate development of technologies for contaminated water diving.</li> <li>- Initiate development of technologies for enhanced navigation and ISR in riverine environments.</li> <li>-Initiate development of technologies to detect and locate IEDs.</li> </ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"> <li>- Continue all efforts of FY 2010, less those noted as completed above.</li> <li>- Complete development of low collateral damage neutralization device.</li> <li>- Complete development of technologies for the detection and disruption of passive and active IR sensors.</li> <li>- Initiate development of technologies to access Improvised IEDs.</li> </ul>											
Accomplishments/Planned Programs Subtotals						46.074	40.710	36.833	0.000	36.833	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0603782N: <i>MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY</i>	34.315	21.591	21.941	0.000	21.941	4.373	4.483	2.810	0.000	0.000	89.513
<b>D. Acquisition Strategy</b> N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>	PROJECT 0000: <i>Mine &amp; Exp Warfare Applied Res</i>
<p><b>E. Performance Metrics</b></p> <p>The overall metrics of this applied research program are the development of technologies which focus on the Expeditionary Warfare challenge of speeding the tactical timeline and increasing safe standoff from minefields. Individual project metrics include the transition of 6.2 technology solutions into 6.3 advanced technology programs.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	6.981	3.187	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	30.942
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Electromagnetic Signatures Assessment System Using Multiple Autonomous Undersea Vehicles, Phase III  <i>FY 2009 Accomplishments:</i> This effort supported the development of algorithms needed to control a fleet of small autonomous underwater vehicles through the integration of inexpensive, easily deployable electromagnetic and acoustic measurement systems trained to work together to assess the electromagnetic or acoustic signature of a forward deployed vessel.  <i>FY 2010 Plans:</i> Continue this effort to support Electromagnetic Signatures Assessment System Using Multiple Autonomous Undersea Vehicles, Phase III research.							1.596	1.992			
Congressional Add: Virtual Onboard Analyst For Multi-Sensor Mine Detection  <i>FY 2009 Accomplishments:</i> This effort supported the development of greater diversity in data covering the wide range of phenomenology needed to remove clutter and improve false alarms with regard to base and operate littoral mine countermeasure systems.							0.997	1.195			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> Continue this effort to support Virtual Onboard Analyst for Multi-Sensor Mine Detection research.		
Congressional Add: Detection and Neutralization of Electronically Initiated Improved Explosive Devices (IEDs)  <i>FY 2009 Accomplishments:</i> This effort supported the continued development and demonstration of an effective and suitable IED detection and neutralization system through use of a magnetic pulse system. The system also provided a viable means of neutralization verification.	1.995	0.000
Congressional Add: Water Security Program (Inland Water Quality and Desalination)  <i>FY 2009 Accomplishments:</i> This effort supported the development of a user friendly costing program to evaluate the economics for the use of various desalination technologies for inland brackish water desalination, development of electrodialysis as an efficient and cost effective means to desalinate brackish water, and the development of a program involving participation of students from NMSU in studies at the Brackish Groundwater National Desalination Research Facility in Alamogordo, NM.	2.393	0.000
Congressional Adds Subtotals	6.981	3.187
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602782N: <i>Mine &amp; Exp Warfare Applied Res</i>	PROJECT 9999: <i>Congressional Adds</i>
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	96.837	116.191	117.908	0.000	117.908	91.301	76.054	79.589	80.425	Continuing	Continuing
2911: Power Proj Adv Tech	75.096	97.549	117.908	0.000	117.908	91.301	76.054	79.589	80.425	Continuing	Continuing
9999: Congressional Adds	21.741	18.642	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	163.299
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>This program develops and demonstrates advanced technologies, including Em Rail Gun for naval weapon systems. This Program Element (PE) includes elements of the following Future Naval Capabilities (FNCs); Time Critical Strike, and ForceNet. Within the Naval Transformation Roadmap, this investment will achieve one of four key transformational capabilities required by Sea Strike as well as technically enable elements of both Sea Shield and Force Net.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0603114N: Power Projection Advanced Technology			
BA 3: Advanced Technology Development (ATD)					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	81.675	107.969	0.000	0.000	0.000
Current President's Budget	96.837	116.191	117.908	0.000	117.908
Total Adjustments	15.162	8.222	117.908	0.000	117.908
• Congressional General Reductions		-0.484			
• Congressional Directed Reductions		-10.000			
• Congressional Rescissions	0.000	-0.014			
• Congressional Adds		18.720			
• Congressional Directed Transfers		0.000			
• Reprogrammings	20.375	0.000			
• SBIR/STTR Transfer	-5.213	0.000			
• Program Adjustments	0.000	0.000	117.908	0.000	117.908
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: AARGM Counter Air Defense Future Capabilities				0.000	1.992
Congressional Add: Countermine LIDAR UAV-Based System (10)				0.000	1.593
Congressional Add: Mobile and Asymmetric Target ID, Detect, Track				0.000	1.992
Congressional Add: Flow Path Analysis Tool				0.000	1.593
Congressional Add: Moving Target Indicator Scout Radar				0.000	0.797
Congressional Add: Tactical High Speed Anti-Radiation Missile Propulsion Demonstration				0.000	1.514
Congressional Add: X-49A Envelope Expansion Modifications				0.000	3.585
Congressional Add: HIGH SPEED ANTI-RADITATION DEMONSTRATION (HSAD)				0.798	0.000
Congressional Add: INFORMATION SHARING FOR ISR TARGETING & ENGAGEMENT				1.596	0.000
Congressional Add: LONG WAVELENGTH ARRAY				2.792	0.000
Congressional Add: SMART INSTRUMENT DEVELOPMENT FOR THE MAGDALENA RID				6.980	3.983

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Advanced Ship Self Defense Technology Testing</i>		3.989	0.000
Congressional Add: <i>Countermining LIDAR UAV-based System</i>		1.197	0.000
Congressional Add: <i>Quiet Drive Advanced Rotary Actuator</i>		1.995	1.593
Congressional Add: <i>Realtime Hyperspectral Targeting Sensor</i>		2.394	0.000
Congressional Add Subtotals for Project: 9999		21.741	18.642
Congressional Add Totals for all Projects		21.741	18.642
<b><u>Change Summary Explanation</u></b>			
Technical: Not applicable.			
Schedule: Not applicable.			
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy								DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology				PROJECT 2911: Power Proj Adv Tech			
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
2911: Power Proj Adv Tech	75.096	97.549	117.908	0.000	117.908	91.301	76.054	79.589	80.425	Continuing	Continuing

Note

Includes new start - cooperative Navy/DARPA Program for the Long Range Anti-Ship Missile (LRASM) Program.

A. Mission Description and Budget Item Justification

This project supports the Time Critical Strike (TCS) and ForceNet FNC components which address technological issues associated with the development of strike weapons to significantly decrease the launch to engagement timeline; provide the Navy of the future the ability to quickly locate, target, and strike critical targets; and enhance mission capabilities and operational utility of Naval forces by dramatically increasing the autonomy, performance, and affordability of Naval organic Unmanned Vehicle systems.

B. Accomplishments/Planned Program (\$ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
PRECISION STRIKE TECHNOLOGY <div><div>This activity focuses on the development of high speed (Mach 3 to Mach 4+) strike technologies which significantly decrease the engagement timeline from multiple sea surface and air launched platforms.</div><div>The increase in funding between FY 2009 and FY 2010 is due to the significant increase in the 6.3 demonstration portion of the Electromagnetic (EM) Railgun Program and cooperative Navy/DARPA Program for the Long Range Anti-Ship Missile (LRASM) Program.</div><div>FY 2009 Accomplishments:<div>EM Gun:<div>- Continued development and testing of barrel life components with EM lab launcher expanding to 16 Mega-Joule (MJ) of muzzle energy.</div></div></div></div>	39.963	83.389	100.503	0.000	100.503

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology		PROJECT 2911: Power Proj Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of industry advanced launcher prototypes, completing the preliminary design review and initiating detail design activities and component hardware testing.</li><li>- Continued development and testing of projectile component concepts, completing unitary lethality demo and initiating a dispense lethality demo.</li><li>- Continued ship integration study efforts.</li><li>- Completed INP Phase I program mid-way assessment.</li><li>- Completed fabrication and installation of pulsed power modules for the Electromagnetic Launch Facility (EMLF).</li></ul> <p>RATTLRS:</p> <ul style="list-style-type: none"><li>- Completed RATTLRS flight test demonstration.</li><li>- Completed data reduction of flight demonstration.</li></ul> <p>Acquisition Workforce Fund</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p>FY 2010 Plans:</p> <p>EM Gun:</p> <ul style="list-style-type: none"><li>- Continue development and testing of barrel life components with EM lab launcher expanding to 32 MJ of muzzle energy.</li><li>- Continue development of industry advanced launcher prototypes, completing detail design activities and initiating detail design fabrication.</li><li>- Continue development and testing of projectile component concepts, completing the dispense lethality demo and initiating 32 MJ muzzle energy tests.</li><li>- Continue ship integration study efforts.</li><li>- Initiate planning for FY 2011 final INP Phase I assessment.</li><li>- Initiate next generation pulsed power concept design.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology		PROJECT 2911: Power Proj Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
LRASM: - New Start: DARPA initiated effort for development of missile preliminary designs and perform analysis demonstrating designs compliant with program requirements and that subsystem technologies development plans have acceptable risk, schedule and cost. - Initiate detailed hardware design.  FY 2011 Base Plans: EM Gun: - Continue ship integration study efforts. - Complete next generation pulsed power concept design. - Complete development and testing of single shot barrel life components with EM lab launcher at 32 MJ of muzzle energy including a 100 shot demo. - Complete development of industry advanced launcher prototypes including delivery and installation at EMLF facility for government test and evaluation with 100 shot demo and 3 shot burst assessment. - Complete development and testing of projectile component at 32 MJ muzzle energy. - Complete final INP Phase I assessment.  LRASM: - Complete detailed hardware design. - Initiate/Complete component and subsystem functionality and fit are demonstrated. - Initiate flight hardware fabrication.  Weapons System Improvement: - Initiate kill-chain studies to identify and recommend engineering trades to enable weapon system interoperability and data fusion alternatives. These studies will assess engineering feasibility of various kill-chain options and assess the capability provided.						
STRIKE AND LITTORAL COMBAT TECHNOLOGIES		35.133	14.160	17.405	0.000	17.405

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology		PROJECT 2911: Power Proj Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The focus of this activity is on those technologies that will support the Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets. This activity includes support to the following FNC Enabling Capabilities (ECs): Advanced Naval Fires Technology, Hostile Fire Detection and Response, Dynamic Target Engagement &amp; Enhanced Sensor Capabilities, and Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets.</p> <p>The fluctuations in the funding profile from FY 2009 through FY 2010 are a combination of funding additional FNC projects while other FNC projects are completing. This Activity reflects the alignment of investments for the following ECs: Dynamic Target Engagement &amp; Enhanced Sensor Capabilities, Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets and Enhanced Weapons Technologies. Increased Capability Against Moving and Stationary Targets, Counter Air Mid-Range Air-to-Air Missile (AMRAAM)/Defense/High Speed Improvements, Multi-Target Laser Designator and Selectable Output Components.</p> <p><i>FY 2009 Accomplishments:</i> FY 2009 Accomplishments: Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: - Continued Weapons Data Link (WDL) hardware and software demonstration of a weapons data link terminal that will allow robust in-flight control of strike weapons at greater standoff ranges with reduced power/space/weight requirements, and improved protection against Electronic Counter Measures (ECM). - Completed Long Cost Imaging Terminal Seeker (LCITS) project, including captive carry of the weapon integrated seeker and upgraded launcher and firing two guided rounds within a tactically relevant environment.</p> <p>Dynamic Target Engagement &amp; Enhanced Sensor Capabilities:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology		PROJECT 2911: Power Proj Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued effort to provide a low-cost, single board radar system suitable for use on a long endurance Unmanned Air Vehicle (UAV).</p> <p>- Continued effort to provide affordable, high endurance platform/propulsion with Commercial Off the Shelf (COTS) and modified COTS components for persistent Intelligence, Surveillance and Reconnaissance (ISR), targeting, Bomb Damage Assessment/Bomb Damage Indication (BDA/BDI),and weapon delivery.</p> <p>- Continued development of Electro Optic/Infrared (EO/IR) sensors and foliage penetration radars suitable for high resolution imaging of ground threats through rain, fog, and camouflage from smallUAVs.</p> <p>- Completed Decision Support for Dynamic Target Engagement, and Ultra Endurance UAV efforts.</p> <p>Increased Capability Against Moving and Stationary Targets:</p> <p>- Continued the Direct Attack Seeker Head (DASH) project to drive down seeker cost during the procurement and test of the infrared imaging seeker components.</p> <p>- Continued Multi-Mode Sensor/Seeker (MMSS) project to conduct a Concept Design Review (CDR) and initiate the build of a common aperture Laser Radar (LADAR) and infrared sensor system.</p> <p>Enhanced Weapons Technologies:</p> <p>Maintain development of advanced technologies that support delivery of Navy approved FNC ECs structured to close operational capability gaps in power projection. Package advanced power projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period. Mature power projection technologies that support naval requirements identified within the Sea Strike and FORCEnet naval capability pillars.</p> <p>- Initiated three new products to address short-falls in current Counter Air (CA) and Counter Air Defense (CAD) capabilities by providing improved range and end-game maneuverability while decreasing Time-of-Flight.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603114N: Power Projection Advanced Technology		PROJECT 2911: Power Proj Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated definition and documentation of system level requirements for airframe, thrust level,insensitive-munitions and safety/reliability for CA Advanced Mid-Range Air-to-Air Missile (AMRAAM)Improvements.</li><li>- Initiated definition and documentation of system level requirements for CAD.</li><li>- Initiated definition and documentation of system level requirements for High Speed Components.</li></ul> <p><i>FY 2010 Plans:</i> Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets:</p> <ul style="list-style-type: none"><li>- Continue Weapon Data Link project by demonstrate the performance capability of the system and the architecture develop under the project.</li></ul> <p>Increased Capability Against Moving and Stationary Targets:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p>Enhanced Weapon Technologies:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Completed Ultra Endurance UAV efforts.</li></ul> <p><i>FY 2011 Base Plans:</i> Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets:</p> <ul style="list-style-type: none"><li>- Complete Weapon Data Link project by demonstrating the performance capability of the system and the architecture develop under the project.</li></ul> <p>Increased Capability Against Moving and Stationary Targets:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate research for advanced optical techniques to enable multiple simultaneous target designation in order to defeat multiple simultaneous targets or SWARM attacks.</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy							<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>			<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>			<b>PROJECT</b> 2911: <i>Power Proj Adv Tech</i>					
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<p>- Initiate Strike Accelerator program. This effort will provide an advanced airborne capability to accurately identify targets using Advanced Target Recognition (ATR). These capabilities utilizing the F/A-18 E/F, AESA (Active Electronically Scanned Array) Radar and ATFLIR (Advanced Targeting Forward Looking Infrared) sensors will enable Strike Aircraft to quickly ID and Target maritime threats.</p> <p>Selectable Output Weapon:</p> <p>- Initiate Selectable Output Weapon Sea Strike Project. This project will develop and integrate new technologies to enable real-time selection of a munitions energetic output.</p> <p>Enhanced Weapon Technologies:</p> <p>- Continue all efforts of FY 2010.</p> <p>- Initiate development of advanced technologies that support delivery of Navy approved FNC enabling capabilities structured to close operational capability gaps in power projection.</p> <p>- Initiate package advanced power projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period.</p> <p>- Initiate mature power projection technologies that support naval requirements identified within the Sea Strike and FORCEnet naval capability pillars.</p>											
Accomplishments/Planned Programs Subtotals						75.096	97.549	117.908	0.000	117.908	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0602114N: <i>POWER PROJECTION APPLIED RESEARCH</i>	7.923	6.765	10.651	0.000	10.651	14.433	10.088	5.248	1.458	0.000	56.566
<b>D. Acquisition Strategy</b>											
N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	R-1 ITEM NOMENCLATURE PE 0603114N: <i>Power Projection Advanced Technology</i>	PROJECT 2911: <i>Power Proj Adv Tech</i>
<p><b>E. Performance Metrics</b></p> <p>The metrics used are programmatic milestones and technical milestones such as flight test and testing of projectile concepts for technical demonstration programs; Technology Transition Agreements (TTAs) which are agreements between the Office of Naval Research and an acquisition program office to transition FNC 6.3 technologies into an acquisition program.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	21.741	18.642	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	163.299
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: AARGM Counter Air Defense Future Capabilities							0.000	1.992			
<i>FY 2010 Plans:</i> This effort supports AARGM Counter Air Defense Future Capabilities research.											
Congressional Add: Countermine LIDAR UAV-Based System (10)							0.000	1.593			
<i>FY 2010 Plans:</i> This effort supports the Countermine Lidar UAV-Based System (CLUBS) research.											
Congressional Add: Mobile and Asymmetric Target ID, Detect, Track							0.000	1.992			
<i>FY 2010 Plans:</i> This effort supports Detection, Tracking, and Identification for ISRTE of Mobile Asymmetric Targets research.											
Congressional Add: Flow Path Analysis Tool							0.000	1.593			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Flow Path Analysis Tool research.		
Congressional Add: Moving Target Indicator Scout Radar <i>FY 2010 Plans:</i> This effort supports Moving Target Indicator Scout Radar research.	0.000	0.797
Congressional Add: Tactical High Speed Anti-Radiation Missile Propulsion Demonstration <i>FY 2010 Plans:</i> This effort supports Tactical High Speed Anti-Radiation Missile Propulsion Demonstration research.	0.000	1.514
Congressional Add: X-49A Envelope Expansion Modifications <i>FY 2010 Plans:</i> This effort supports X-49A Envelope Expansion Modifications research.	0.000	3.585
Congressional Add: HIGH SPEED ANTI-RADITATION DEMONSTRATION (HSAD) <i>FY 2009 Accomplishments:</i> This effort supported the Variable Flow Ducted Rocket Ramjet propulsion concept during the HSAD Project, by investigating the application of this propulsion concept to meet evolving requirements for a near term, reactive, long range weapon system.	0.798	0.000
Congressional Add: INFORMATION SHARING FOR ISR TARGETING & ENGAGEMENT	1.596	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development of algorithms to identify and track the highest threat targets among multiple targets for Joint Direct Attack Munition (JDAM) systems.		
Congressional Add: LONG WAVELENGTH ARRAY  <i>FY 2009 Accomplishments:</i> This effort supported the completion of the design of the long wavelength array through CDR. 256 antenna and receiver pairs were fabricated and deployed into an array. The array was tested for the ability to form and steer the low frequency beam.	2.792	0.000
Congressional Add: SMART INSTRUMENT DEVELOPMENT FOR THE MAGDALENA RID  <i>FY 2009 Accomplishments:</i> This effort supported Smart Instrument Development for Magdalena Ridge Observatory (MRO) research.  <i>FY 2010 Plans:</i> Continues support of Smart Instrument Development for the Magdalena Ridge Observatory research.	6.980	3.983
Congressional Add: Advanced Ship Self Defense Technology Testing  <i>FY 2009 Accomplishments:</i> This effort supported the development and testing of new era of self-defense capabilities for U. S. Naval vessels.	3.989	0.000
Congressional Add: Countermine LIDAR UAV-based System	1.197	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported development of the Rapid Environmental Assessment (REA) software for estimating seafloor type and water column optical properties from LIDAR and passive hyperspectral reflectance data. The REA software was tested in turbid, shallow waters, and the algorithms and software have been modified to produce improved seafloor images and seafloor classifications.		
Congressional Add: Quiet Drive Advanced Rotary Actuator  <i>FY 2009 Accomplishments:</i> This effort supported performance improvement and lifecycle cost advantage of the quiet drive advanced rotary actuator over the hydraulic rotary actuator.  <i>FY 2010 Plans:</i> Continues support of Quiet Drive Advanced Rotary Actuator research.	1.995	1.593
Congressional Add: Realtime Hyperspectral Targeting Sensor  <i>FY 2009 Accomplishments:</i> This effort supported the implementation of the Real-Time Hyper-Spectral Targeting Sensor Program designed to address High-Threat Time Critical Strike, Rapid Movement of Mobile/Emergent Target Data to Shooters, Persistent ISR and TTTL for Accurate Target Discrimination and Location, and Situational Awareness and Understanding.	2.394	0.000
Congressional Adds Subtotals	21.741	18.642

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603114N: <i>Power Projection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603123N: Force Protection Advanced Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	121.465	92.962	61.877	0.000	61.877	54.554	54.323	43.751	44.952	Continuing	Continuing
2912: Force Protection Advanced Technology	61.086	63.426	59.405	0.000	59.405	52.035	51.757	41.125	42.271	Continuing	Continuing
3049: Force Protection	2.177	2.330	2.472	0.000	2.472	2.519	2.566	2.626	2.681	Continuing	Continuing
9999: Congressional Adds	58.202	27.206	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	317.675

**A. Mission Description and Budget Item Justification**

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This program supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. This PE supports the Future Naval Capabilities (FNC) in the areas of Sea Shield and Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE). The goal of this program is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Surface Ship & Submarine, Hull, Mechanical & Electrical (HM&E), Missile Defense, Fleet Force Protection and Defense against Undersea Threats, and Emerging Threats activities all support FNC efforts.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0603123N: Force Protection Advanced Technology			
BA 3: Advanced Technology Development (ATD)					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	113.502	66.035	0.000	0.000	0.000
Current President's Budget	121.465	92.962	61.877	0.000	61.877
Total Adjustments	7.963	26.927	61.877	0.000	61.877
• Congressional General Reductions		-0.388			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.005			
• Congressional Adds		27.320			
• Congressional Directed Transfers		0.000			
• Reprogrammings	9.653	0.000			
• SBIR/STTR Transfer	-1.290	0.000			
• Program Adjustments	0.000	0.000	61.877	0.000	61.877
• Rate/Misc Adjustments	-0.001	0.000	0.000	0.000	0.000
• Congressional Recision Adjustments	0.001	0.000	0.000	0.000	0.000
• Congressional Add Adjustments	-0.400	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Captive Air Amphibious Transporter (CAAT)					
Congressional Add: HBCU Applied Research Incubator					
Congressional Add: High-Temperature Radar Dome Materials					
Congressional Add: Multi-Element Structured Filter Arrays for Naval Platforms					
Congressional Add: NAVAIR Project for Land/Sea-Based Air Systems Maintenance and Air Worthiness					
Congressional Add: Pure Hydrogen Supply from Logistic Fuels					
Congressional Add: AGILE PORT AND HIGH SPEED SHIP TECHNOLOGY					
Congressional Add: M65 BIEMALOIMIDE CARBON FIBER PREREG					
Congressional Add: MANUFACTURING & REPAIR CELL					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Remote Continuous Energetic Material Manufacturing</i>		1.596	0.000
Congressional Add: <i>SOLID STATE DC PROTECTION SYS</i>		1.197	0.000
Congressional Add: <i>Center for Applied Research in Intelligent Autonom</i>		2.394	0.000
Congressional Add: <i>SINGLE GENERATOR OPERATIONS LITHIUM ION BATTERY</i>		3.988	3.983
Congressional Add: <i>High Power Density Motor Drive</i>		0.997	2.868
Congressional Add: <i>Stabilized Laser Designation Capability</i>		1.995	0.000
Congressional Add: <i>WIDE AREA SENSOR FOR FORCE PROTECTION TARGETING</i>		1.596	1.593
Congressional Add: <i>ACCELERATED FUEL CELLS MANUFACTURABILITY AND THEIR</i>		2.394	1.593
Congressional Add: <i>ADVANCED LOGISTICS FUEL REFORMER FOR FUEL CELLS</i>		2.394	2.390
Congressional Add: <i>ELECTROCHEMICAL FIELD-DEPLOYABLE SYS FOR POTABLE</i>		2.791	0.000
Congressional Add: <i>FORMABLE TEXTILE FOR COMPLEX SHAPED AEROSPACE COMP</i>		1.596	0.000
Congressional Add: <i>FUTURE FUEL NON-TACTICAL VEHICLE INITIATIVE</i>		1.596	0.000
Congressional Add: <i>LASER PERIMETER AWARENESS SYSTEM</i>		1.496	0.000
Congressional Add: <i>MULTI FUEL COMBUSTOR FOR SHIPBOARD FUEL CELLS</i>		1.596	0.000
Congressional Add: <i>UNDERGROUND COORDINATION OF MANAGED MESH-NETWORKS</i>		2.394	0.000
Congressional Add: <i>Advanced Continuous Active Sonar for UUVs</i>		2.492	0.000
Congressional Add: <i>Durability energy saving and sustainability</i>		0.798	0.000
Congressional Add: <i>High Temperature Superconductor Trap Field Magnet</i>		1.995	0.797
Congressional Add: <i>Improved Stealth and Lower Cost Operations for Shi</i>		1.596	0.000
Congressional Add: <i>Integrated Ship and Motion Control Technology</i>		3.430	0.000
Congressional Add: <i>Self Healing Target System for Laser and Sniper Ra</i>		1.596	0.000
Congressional Add: <i>Strategic/Tactical Resource Interoperability Kinet</i>		1.117	0.000

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Ultra-Wide Coverage Visible Near Infrared Sensor f</i>		1.197	0.000
Congressional Add: <i>Video and Water Mist Technologies for Incipient Fi</i>		3.190	0.000
Congressional Add: <i>Solid Oxide Fuel Cell</i>		0.798	0.000
Congressional Add Subtotals for Project: 9999		58.202	27.206
Congressional Add Totals for all Projects		58.202	27.206
<b><u>Change Summary Explanation</u></b>			
Technical: Not applicable.			
Schedule: Not applicable.			
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>				<b>PROJECT</b> 2912: <i>Force Protection Advanced Technology</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2912: <i>Force Protection Advanced Technology</i>	61.086	63.426	59.405	0.000	59.405	52.035	51.757	41.125	42.271	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. It supports the Sea Shield and Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE) -- Future Naval Capabilities (FNCs). The goals of this project are to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability.

This Project reflects the alignment of investments for the following ECs: Total Ship Survivability Damage Tolerance and Recoverability; Over-the-Horizon Missile Defense; Two-Torpedo Salvo Defense; Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats; Sea Based Missile Defense of Ships & Littoral Installations; Aircraft Integrated Self-Protection Suites; Hostile Fire Detection and Response Spirals 1 and 2; Four-Torpedo Salvo Defense; Shipboard Force Protection in Port and Restricted Waters - Detection and Classification; and Underwater Total Ship Survivability.

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS</b>	15.525	19.663	17.441	0.000	17.441
Fleet Force Protection and Defense against Undersea Threats addresses efforts that include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats.					
The first major goal of this activity is to develop complementary sensor and processing technologies for 21st century warfighting success and platform protection. Current small platforms (both surface and airborne) have little or no situational awareness (SA) or self-protection against air, surface, and					

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B. Accomplishments/Planned Program (\$ in Millions)							
			FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>asymmetric threats. This activity will provide tactical aircraft (TACAIR) and other platforms with effective threat warning and self-protection. The technology areas specific to platform protection will develop individual or multi-spectral [Electro-Optic (EO), IR, radio frequency (RF), EM, visual, and acoustic] sensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multi-spectral detection and distribution of specific threat information.</p> <p>The Fleet Force Protection portion of this activity includes support to the FNC Enabling Capabilities for: Aircraft Integrated Self-protection Suites; Intent Determination - EO/IR Enhancements; Proof-of-Concept for Non-lethal Approach; Advanced Electronic Sensor Systems for Missile Defense; Hostile Fire Detection and Response Spirals 1 and 2; Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats; Four-Torpedo Salvo Defense; and Shipboard Force Protection in Port and Restricted Waters - Detection and Classification.</p> <p>The second major goal of this activity is to develop enabling technologies that will increase the survivability of surface ship and submarine platforms against torpedo threats. Proposed technologies focus on defeating high priority threats including torpedoes (i.e. straight running, wake homing, acoustic homing, air dropped torpedoes, and salvoes of torpedoes). Technologies developed will minimize shipboard impact and require no shipboard organizational maintenance. The Anti-Torpedo Torpedo (ATT) provides technologies that enable an ATT to engage threat torpedoes detected by a surface ship towed sensor system. The ultimate goal is to develop technologies to enable a torpedo defense capability, including ship self-defense against salvo torpedo attacks, to fill the FNC Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats. Ultimately the goal is to deliver an anti-torpedo-torpedo for use in defeating a four-torpedo salvo attack against a surface platform.</p>							

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The increase in funding from FY 2009 to FY 2010 is due to the ramping up of the following Future Naval Capability Enabling Capabilities: Shipboard Force Protection in Port and Restricted Waters - Detection and Classification, Four-Torpedo Salvo Defense, Advanced Threat Aircraft Countermeasures, and Helicopter Low-Level Operations (HELO).</p> <p><i>FY 2009 Accomplishments:</i></p> <p>Sensors &amp; Associated Processing -</p> <ul style="list-style-type: none"><li>- Continued new FNC Enabling Capability (EC) Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. This project will develop mission specific electro-optic/infrared sensors to detect, classify, and determine the intent of potential terrorist and special operations force threats to ships and craft in port and transiting restricted waters.</li><li>- Initiated the Countermeasures for Advanced Imaging Infrared (IIR) Guided Missiles FNC effort by commencing IIR threat surrogate hardware development.</li><li>- Initiated the Countermeasures for Millimeter Wave Guided Missiles FNC effort by initiating wide band gap monolithic microwave integrated circuit (MMIC) Ka-band development.</li><li>- Initiated the Multifunction Capabilities for Missile Warning Sensors FNC effort by commencing signal processor development.</li><li>- Initiated the Helicopter Laser-Based Landing Aids FNC effort by commencing laser technologies development.</li></ul> <p>Underwater Platform Self-Defense -</p> <ul style="list-style-type: none"><li>- Continued the development of low-cost, light-weight swimmer detection and localization technologies.- Initiated expanded development of autonomous, underway refueling for Unmanned Sea Surface Vehicle Technologies.</li><li>- Initiated advanced development of software encoded algorithms for the Anti-Torpedo Torpedo (ATT) sensor and controller that will enable ATT's to successfully engage torpedo salvos of up to four attacking units.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund.						
FY 2010 Plans: Sensors & Associated Processing - - Continue all efforts of FY 2009.						
Underwater Platform Self-Defense - - Continue all efforts of FY 2009. - Complete development and demonstration of low-cost, light-weight swimmer detection and localization technologies.						
FY 2011 Base Plans: Sensors & Associated Processing - - Continue all efforts of FY 2010. - Complete FNC EC Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. This effort develops mission specific electro-optic/infrared sensors to detect, classify, and determine the intent of potential terrorist and special operations force threats to ships and craft in port and transiting restricted waters. Sensor projects included in this FNC EC include Distributed Millimeter Wave (DmmW) Sensor, Active/Passive Dual Imaging IR (MW/SW) Sensor, and Situational Panoramic Infrared (SPIR) Sensor.						
Underwater Platform Self-Defense - - Continue all efforts of FY 2010, less those noted as completed above.						
In support of FNC (Force Projection Advanced Technology), perform the following efforts - - Initiate the development of advanced technologies that support delivery of Navy approved FNC enabling capabilities structured to close operational capability gaps in force projection.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate the packaging of advanced force projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period.</li><li>- Initiate the development of force projection technologies that support naval requirements identified within the Sea Shield and Sea Strike naval capability pillars as well as those applicable to specific naval platforms and those that apply across the naval enterprise.</li></ul>						
MISSILE DEFENSE (MD)  This activity describes Missile Defense Science and Technology (S&T) projects of the Sea Shield Future Naval Capability (FNC) program and an OSD-funded Joint Integrated Fire Control (JIFC) demonstration. <ul style="list-style-type: none"><li>- Advanced Area Defense Interceptor (AADI) S&amp;T planning and data analysis effort for Navy-Marine Corps Air-Directed Surface-to-Air Missile (ADSAM) live firing demonstration at White Sands Missile Range in May 2009. The metric for AADI was execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability.</li><li>- Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile (SM) future missile. Metrics will be to achieve SM performance requirements in specified tactical rain environments and all specified electronic countermeasures environments, while meeting the planned transition date.</li><li>- Extended Distributed Weapons Coordination (EDWC) algorithms to extend Distributed Weapons Coordination (DWC) Automated Battle Management Aids (ABMA) functionality to include coordination of passive defense measures (emission control, use of decoys, maneuvering). Metrics will be improved probability of negation (Pneg) against advanced ballistic &amp; cruise missile anti-ship threats that may be susceptible to decoys &amp; jamming, while meeting the planned transition date.</li><li>- Positive Control of Naval Weapons (PCNW) - additional technology upgrades for SM to enable forward relay, remote launch and potentially forward pass engagements. Metrics are classified.</li><li>- Midcourse and Terminal Algorithms (MTA) for interceptor and associated weapon system enhancements to defeat advanced anti-ship missile threats with high confidence. Specific metrics are classified.</li></ul>		29.986	16.745	24.184	0.000	24.184

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Enhanced Lethality Guidance Algorithms (ELGA) to increase probability of kill versus an expanded threat set including ASBMs and advanced ASCMs. Metrics for this project will be classified.</p> <p>- Enhanced Maneuverability Missile Airframe (EMMA) technology for Navy shipboard missile systems to intercept highly agile maneuvering ASCMs and ASBMs. Metrics for this project will be classified.</p> <p>- Integrated Active &amp; Electronic Defense (IAED) technology basis for response combinations of active and electronic weapons &amp; systems to optimize Pneg against ASBMs and ASCMs, including potential interactions. Metrics will be classified.</p> <p>- Joint Integrated Fire Control (JIFC) S&amp;T planning and preparations, non-FNC expansion of the AADI ADSAM demonstration, to support participation of Army, Air Force and coalition sensor and weapon test assets. The metric for this expanded participation was a series of demonstrations in FY08-09 that showed a technology basis for effective interoperability with Navy and Marine Corps participating systems to defend expeditionary forces from air and missile attacks.</p> <p>Funding decreases in FY 2009 to FY 2010 reflects completion of AADI and JIFC projects. Funding increases from FY 2010 to FY 2011 as a result from EDWC, NII and PCNW project funding migrating from Applied Research (6.2) to Advanced Research (6.3) in their last year of effort before transition to acquisition. The MTA project ramps up in FY2010 while the ELGA and EMMA projects start in FY2010, also accounting for part of this increase.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>- Continued EDWC, NII and PCNW project efforts.</p> <p>- Initiated MTA project efforts.</p> <p>- Completed AADI project and JIFC effort.</p> <p><i>FY 2010 Plans:</i></p> <p>- Continue all efforts of FY 2009, less those noted as completed above.</p> <p>- Initiate ELGA and EMMA project efforts.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Complete EDWC, NII and PCNW efforts. - Continue MTA and ramp up of the ELGA and EMMA projects. - Initiate IAED project effort.						
SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E)  Activity includes: Signature Reduction, Hull Life Assurance, and Advanced Capability Electric Systems. Signature Reduction addresses electromagnetic (EM), infrared (IR), and acoustic signature tailoring, both topside and underwater. Hull Life Assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapon effects to control structural damage and the improvement of structural materials. Advanced Capability Electric Systems area addresses electrical and auxiliary systems and component technology to provide improvements in system energy and power density, system operating efficiency, and recoverability from casualties. Advanced Damage Control Countermeasures addresses fire, smoke, and flooding detection using a volume sensor and the use of a hybrid water-mist for electronic space protection. This activity includes support to the Sea Strike, Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE) FNC programs.  The increase of funding from FY 2009 to FY 2010 is due to the initiation of new FNC Enabling Capabilities including Underwater Total Ship Survivability, and Affordable Submarine Propulsion and Control Actuator; and the realignment of Compact Power Conversion Technologies from PE 0603236N/ Turbine Engine Technology. The decrease in funding from FY2010 to FY2011 is for the Advanced Naval Power Next Generation Systems (NGIPS) development, a separate effort from the ongoing Compact Power Conversion FNC. The NGIPS effort is ramping down; the FNC efforts will be entering Phase III in FY11.		15.575	27.018	17.780	0.000	17.780

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued development of diesel fuel reforming technology for molten carbonate and proton exchange membrane fuel cells. - Continued risk reduction activities of advanced superconducting homopolar main propulsion motor with General Atomics. - Continued development of autonomous recovery system for Unmanned Sea Surface Vehicles from a host ship. - Continued development of thermal management technology for shipboard power distribution. - Continued development of Integrated Damage Control Systems which includes Integrated Damage Control Communications and Advanced Magazine Protection System. - Continued compact power conversion technologies FNC transitioned from PE 0603236N/Turbine Engine Technology. - Continued Total Ship Survivability Damage Tolerance and Recoverability efforts which include integrated damage control situation awareness technologies. - Continued expansion of the Next Generation Integrated Power Systems (NGIPS) technology development, to de-risk and demonstrate applicable Medium Voltage Direct Current (MVDC) power dense, efficient, and fault tolerant technologies needed for future surface, and subsurface platforms. - Completed risk reduction activities associated with advanced direct current homopolar motor with General Atomics. - Initiated expanded demonstration of superconductive degaussing coil in a relevant environment. - Initiated Affordable Submarine Propulsion and Control Surface Actuator technologies focused on the development and demonstration of affordable advanced material propellers and torque dense and quiet actuation of submarine control surface efforts. - Initiated Underwater Total Ship Survivability/Payload Implosion and Platform Damage Avoidance efforts. - Initiated preliminary designs of control surface actuator systems.						

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
				<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>			
<b><i>FY 2010 Plans:</i></b> - Continue all efforts of FY 2009, less those noted as completed above. - Complete preliminary designs of control surface actuator systems. - Complete expanded demonstration of superconductive degaussing coil in a relevant environment. - Initiate detailed design and breadboard demonstration of control surface actuator systems. - Initiate scaled testing and large scale analysis for ship protection systems. - Initiate Compact Power Conversion Technology Phase 2 Critical Component Development.											
<b><i>FY 2011 Base Plans:</i></b> - Continue all efforts of FY 2010, less those noted as completed above. - Complete detailed design and breadboard demonstration of control surface actuator systems. - Initiate fabrication of scaled control surface actuator systems. - Initiate Compact Power Conversion Technology Phase 3 large Scale Component Development and testing.											
Accomplishments/Planned Programs Subtotals				61.086	63.426	59.405	0.000	59.405			
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0602123N: <i>FORCE PROTECTION APPLIED RESEARCH</i>	26.579	21.747	20.769	0.000	20.769	17.226	9.152	1.238	0.000	0.000	96.711
<b>D. Acquisition Strategy</b>											
N/A											

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## E. Performance Metrics

The overall goals of this advanced technology program are the development of technologies which focus on the warfighter and providing the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Overall metric goals are to transition the advanced technology projects into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include classified quantitative measurements.

Specific examples of metrics under this PE include:

- Demonstrate improved performance of main propulsion electric motors and controllers (50% reduced weight and volume) by FY 2011.
- Demonstration of a Medium Voltage Direct Current (MVDC) architecture containing Commercial Off the Shelf (COTS) components to assess the viability of MVDC distribution for CG (X) cruiser by the end of FY 2011.
- Items included within the Missile Defense Activity description.

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COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
3049: Force Protection	2.177	2.330	2.472	0.000	2.472	2.519	2.566	2.626	2.681	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

Advanced technologies developed, critical to protecting naval installations, will provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to: sense developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.

**B. Accomplishments/Planned Program (\$ in Millions)**

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
EMERGING THREATS	2.177	2.330	2.472	0.000	2.472
<p>This activity includes: Advanced technologies developed, critical to protecting naval installations, will provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to: sense developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued development of lower cost/higher performance Force Protection sensors and automated detection algorithms, and decision support tools.</li><li>- Continued interim demonstration of prototype Force Protection sensors.</li><li>- Continued development of intrusion/incident response countermeasures for Force Protection.</li><li>- Continued full scale demo of swimmer defense system including sensors and response countermeasures.</li></ul>					

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued interim demonstration of force protection detection and response system with automated detection and self learning algorithms.</li><li>- Initiated research to reduce force protection manpower and equipment costs through automation and predictive learning algorithms.</li><li>- Initiated threat characterization research and perception experiments for sensor performance optimization and model development and validation.</li></ul> <p>Acquisition Workforce Fund</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete full scale demo of swimmer defense system including sensors and response countermeasures.</li><li>- Complete interim demonstration of force protection detection and response system with automated detection and self learning algorithms.</li><li>- Initiate development of all weather sensors optimized for installation force protection.</li><li>- Initiate research to advance sensor fusion capabilities in high density networks with diverse sensor grids.</li><li>- Initiate research into sensors for use in counter-surveillance around protected facilities.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Initiate development of assessment algorithms and information analysis technologies to augment skills or replace persons in operations centers.</li></ul>						
Accomplishments/Planned Programs Subtotals		2.177	2.330	2.472	0.000	2.472

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<p><b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A</p> <p><b><u>D. Acquisition Strategy</u></b> N/A</p> <p><b><u>E. Performance Metrics</u></b> The overall goals of this advanced technology program are the development of technologies which will provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to protect naval installations. Overall metric goals are to reduce the required manpower and skill levels devoted to the force protection mission. Specific metric under the Project includes: In-water successful demonstration of warhead lethality against specified threat at required Closest Point of Approach (CPA).</p>		

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<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	58.202	27.206	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	317.675
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Captive Air Amphibious Transporter (CAAT)							0.000	2.191			
<i>FY 2010 Plans:</i> This effort supports Captive Air Amphibious Transporter (CAAT) research.											
Congressional Add: HBCU Applied Research Incubator							0.000	0.797			
<i>FY 2010 Plans:</i> This effort supports HBCU Applied Research Incubator research.											
Congressional Add: High-Temperature Radar Dome Materials							0.000	1.593			
<i>FY 2010 Plans:</i> This effort supports High-Temperature Radar Dome Materials research.											
Congressional Add: Multi-Element Structured Filter Arrays for Naval Platforms							0.000	3.426			

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2010 Plans:</i> This effort supports Multi-Element Structured Filter Arrays for Naval Platforms research.		
Congressional Add: NAVAIR Project for Land/Sea-Based Air Systems Maintenance and Air Worthiness <i>FY 2010 Plans:</i> This effort supports NAVAIR Project for Land/Sea-Based Air Systems Maintenance and Air Worthiness research.	0.000	1.992
Congressional Add: Pure Hydrogen Supply from Logistic Fuels <i>FY 2010 Plans:</i> This effort supports Pure Hydrogen Supply from Logistic Fuels research.	0.000	2.390
Congressional Add: AGILE PORT AND HIGH SPEED SHIP TECHNOLOGY <i>FY 2009 Accomplishments:</i> This effort supported the application of agile port and high-speed ship technology to enhance base and force protection through improved in-transit visibility within the defense transportation system, improved port/terminal military cargo throughput productivity and intermodal interface capability, continued development of enabling technologies for high speed ship hull, machinery systems, and beachable/over-beach delivery concepts in support of high speed logistics and military utilization from CONUS and/or prepositioned ships platforms including "sea bases." <i>FY 2010 Plans:</i> Continue support of Agile Port and High Speed Ship Technology research.	5.983	1.593
Congressional Add: M65 BIEMALOIMIDE CARBON FIBER PREREG	1.596	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the qualification of a third generation controlled flow prepreg system that offers thermal performance with epoxy like manufacturing benefits designed to reduce the cost of structures built with prepregs by reducing in-post machining and shimming and the improvement of weight consistency.		
Congressional Add: MANUFACTURING & REPAIR CELL  <i>FY 2009 Accomplishments:</i> This effort supported the development of an enabling capability to manufacture and repair critical materials and parts as and when needed in order to ensure the readiness of operational forces.	2.394	0.000
Congressional Add: Remote Continuous Energetic Material Manufacturing  <i>FY 2009 Accomplishments:</i> This effort supported the development of infrastructure necessary to develop an energetic material manufacturing technology utilizing a continuous, remote process to compound, granulate and dry the flare composition in a process that does not expose workers to large quantities of the composition.	1.596	0.000
Congressional Add: SOLID STATE DC PROTECTION SYS  <i>FY 2009 Accomplishments:</i> This effort supported the development of a universal solid-state circuit breaker (USSB) for medium voltage Navy power distribution systems. This effort specifically focused on developing programmable thresholds for electrical fault trip points with increased interruption speed within a hybrid USSB designed to operate in Navy medium voltage applications.	1.197	0.000
	2.394	0.000

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Center for Applied Research in Intelligent Autonom  <i>FY 2009 Accomplishments:</i> This effort supported research to reduce the need for human intervention in unmanned systems operations and maintenance, particularly for unmanned surface vehicles, by providing advances in autonomous control, group behavior and planning, unmanned surface vehicle dynamic control, obstacle detection and management, control in rough conditions, supervisory control, and prognostics.		
Congressional Add: SINGLE GENERATOR OPERATIONS LITHIUM ION BATTERY  <i>FY 2009 Accomplishments:</i> This effort supported research into increased shipboard fuel efficiency for a fuel cell-based propulsion system compared with conventional turbine engine technologies.  <i>FY 2010 Plans:</i> Continue support of Single Generator Operations Lithium Ion Battery research.	3.988	3.983
Congressional Add: High Power Density Motor Drive  <i>FY 2009 Accomplishments:</i> This effort supported improved power density to provide the warfighter the benefits of electric drive.  <i>FY 2010 Plans:</i> Continue support of High Power Density Motor Drive research.	0.997	2.868
Congressional Add: Stabilized Laser Designation Capability	1.995	0.000

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development of system design requirements and target tracking algorithms for an enhanced, medium altitude laser designation capability for medium altitude aircraft operations that can address moving targets, as well as targets in a Global Positioning System (GPS)-jammed environment.		
Congressional Add: WIDE AREA SENSOR FOR FORCE PROTECTION TARGETING  <i>FY 2009 Accomplishments:</i> This effort supported the development of a wide area surveillance sensor with day/night capabilities of a sufficient resolution to detect vehicles and individuals for use during forensic backtracking and sociologic pattern analysis and prediction.  <i>FY 2010 Plans:</i> Continue support of Wide Area Sensor Force Protection Targeting research.	1.596	1.593
Congressional Add: ACCELERATED FUEL CELLS MANUFACTURABILITY AND THEIR  <i>FY 2009 Accomplishments:</i> This effort supported research into the manufacturing affordability of solid oxide fuel cells for military and commercial applications.  <i>FY 2010 Plans:</i> Continue support of Accelerating Fuel Cells Manufacturability research.	2.394	1.593
Congressional Add: ADVANCED LOGISTICS FUEL REFORMER FOR FUEL CELLS	2.394	2.390

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development of fuel cell technology and deployable next-generation systems for use with fuel cell systems and components.  <i>FY 2010 Plans:</i> Continue support of Advanced Logistics Fuel Reformer for Fuel Cells (Phase II) research.		
Congressional Add: ELECTROCHEMICAL FIELD-DEPLOYABLE SYS FOR POTABLE  <i>FY 2009 Accomplishments:</i> This effort supported research and development of an energy efficient electrochemical device that generates mixed oxides from saline solution or potentially sea water for the purification/disinfection of potable water.	2.791	0.000
Congressional Add: FORMABLE TEXTILE FOR COMPLEX SHAPED AEROSPACE COMP  <i>FY 2009 Accomplishments:</i> This effort supported the development of infrastructure necessary to provide a stable, consistent environment to support an aircraft manufacturing program utilizing materials which hold promise for reducing manufacturing costs of aerospace-grade, complex curved structural composite parts by enabling, via the materials, improved formability, greater utilization of automated manufacturing technologies as opposed to the current labor intensive hand lay-up methods.	1.596	0.000
Congressional Add: FUTURE FUEL NON-TACTICAL VEHICLE INITIATIVE  <i>FY 2009 Accomplishments:</i> This effort supported the demonstration of fuel cell vehicles and enhanced vehicle range refueling capability.	1.596	0.000

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: LASER PERIMETER AWARENESS SYSTEM  <i>FY 2009 Accomplishments:</i> This effort supported the development of a Laser Perimeter Awareness System (LPAS) providing additional coverage with its laser based sensors to detect waterborne threats in littoral areas bordering Naval installations.	1.496	0.000
Congressional Add: MULTI FUEL COMBUSTOR FOR SHIPBOARD FUEL CELLS  <i>FY 2009 Accomplishments:</i> This effort supported the development of a scaled up Multi-Fuel Combustor capable of integration into a shipboard fuel cell system.	1.596	0.000
Congressional Add: UNDERGROUND COORDINATION OF MANAGED MESH-NETWORKS  <i>FY 2009 Accomplishments:</i> This effort supported the coordination of underground managed mesh networks designed for persistent surveillance, search and rescue, and reduced manning initiatives on ships. This technology can be used both for sensor communications and tracking service members in highly restricted spaces.	2.394	0.000
Congressional Add: Advanced Continuous Active Sonar for UUVs  <i>FY 2009 Accomplishments:</i> This effort supported research focused on the marriage of an advanced SONAR capability with the stealth, standoff features, autonomy and endurance of a large Unmanned Undersea Vehicle (UUV).	2.492	0.000
	0.798	0.000

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Durability energy saving and sustainability  <i>FY 2009 Accomplishments:</i> This effort supported research concerning the unique active nanostructures which provide predictable and extended reliability along with energy savings in severe friction and wear conditions.		
Congressional Add: High Temperature Superconductor Trap Field Magnet  <i>FY 2009 Accomplishments:</i> This effort supported the development of High Temperature Superconductor (HTS) Trap Field Magnet Motors which may be used to help meet power and propulsion requirements for future Navy ships.  <i>FY 2010 Plans:</i> Continue support of High-Temperature Superconductor Trap Field Magnet Motor research.	1.995	0.797
Congressional Add: Improved Stealth and Lower Cost Operations for Shi  <i>FY 2009 Accomplishments:</i> This effort supported the creation of a net that eliminates the threat of radar detection and reduces costs and logistics problems common with other netting.	1.596	0.000
Congressional Add: Integrated Ship and Motion Control Technology  <i>FY 2009 Accomplishments:</i> This effort supported the integration of advancements in intelligent control, advanced motor materials, acoustic silencing, electromechanical power transfer, and high capacity energy storage devices in the challenging shipboard application of high-speed vessel stabilization and ride.	3.430	0.000
Congressional Add: Self Healing Target System for Laser and Sniper Ra	1.596	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development and demonstration of environmentally friendly, self-healing target systems providing long-term cost savings while reducing the incidence of injury to personnel and maintaining readiness.		
Congressional Add: Strategic/Tactical Resource Interoperability Kinet  <i>FY 2009 Accomplishments:</i> This effort supported development of migration applications to utilize open source service oriented architecture standards.	1.117	0.000
Congressional Add: Ultra-Wide Coverage Visible Near Infrared Sensor f  <i>FY 2009 Accomplishments:</i> This effort supported the development of an ultra-wide coverage visible/near infrared (VNIR) sensor with high resolution, high quantum efficiency, very large format VNIR detectors with high fidelity, geospatially accurate optics. These technologies have been integrated into a deployable package suitable for manned, or unmanned, long-range platforms.	1.197	0.000
Congressional Add: Video and Water Mist Technologies for Incipient Fi  <i>FY 2009 Accomplishments:</i> This effort supported the development of video technologies that can detect incipient fires, both smoke and flame.	3.190	0.000
Congressional Add: Solid Oxide Fuel Cell	0.798	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603123N: <i>Force Protection Advanced Technology</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>	
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>			
		<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported testing fuel cell performance under various related air-side contaminant conditions and continued to seek reductions in volumetric- and mass-power density by validating an enhanced fuel blower for a SOFC system.			
Congressional Adds Subtotals		58.202	27.206
<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>			
N/A			
<b><u>D. Acquisition Strategy</u></b>			
N/A			
<b><u>E. Performance Metrics</u></b>			
Congressional Add.			

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	86.583	104.531	96.720	0.000	96.720	55.951	47.983	49.036	40.404	Continuing	Continuing
2919: Communications Security	86.583	102.938	96.720	0.000	96.720	55.951	47.983	49.036	40.404	Continuing	Continuing
9999: Congressional Adds	0.000	1.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.970
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>Activities and efforts in this program address the advanced technology development, test, and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The promise of net-centricity and potential for persistent and pervasive sensing creates greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors, and tailored dissemination of information to support network centric operations. The focus of this program is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments. These missions include the Overseas Contingency Operations (OCO), urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, the Navy must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capabilities, this project demonstrates technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to rapid, accurate decision-making and result in decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.</p>											
<p>The Common Picture Program supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Combatant Commanders (COCOM) to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; Dynamic Command and Control (C2) for Tactical Forces and Maritime Operations</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		PE 0603235N: Common Picture Advanced Technology			
Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; OCO Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; Pro-Active Computer Network Defense and Information Assurance; Fast Magic; and Naval Research Laboratory (NRL) Space.					
In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance; Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).					
Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	90.050	108.394	0.000	0.000	0.000
Current President's Budget	86.583	104.531	96.720	0.000	96.720
Total Adjustments	-3.467	-3.863	96.720	0.000	96.720
• Congressional General Reductions		-0.457			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.106			
• Congressional Adds		1.600			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-1.323	0.000			
• SBIR/STTR Transfer	-2.144	0.000			
• Program Adjustments	0.000	0.000	96.720	0.000	96.720
• Rate/Misc Adjustments	0.000	-4.900	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: 4D Data Fusion Visualization					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
	FY 2009	FY 2010			
	0.000	1.593			
	0.000	1.593			
	0.000	1.593			

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	R-1 ITEM NOMENCLATURE PE 0603235N: <i>Common Picture Advanced Technology</i>	
<p><b><u>Change Summary Explanation</u></b></p> <p>Technical: Not applicable.</p> <p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603235N: <i>Common Picture Advanced Technology</i>				<b>PROJECT</b> 2919: <i>Communications Security</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2919: <i>Communications Security</i>	86.583	102.938	96.720	0.000	96.720	55.951	47.983	49.036	40.404	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

Activities and efforts in this project address the advanced technology development, test, and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The promise of net-centricity and potential for persistent and pervasive sensing creates greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors, and tailored dissemination of information to support network centric operations. The focus of this program is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments. These missions include the OCO, urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, the Navy must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capabilities, this project demonstrates technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to rapid, accurate decision-making and result in decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.

The Communications Security project supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; OCO Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; Pro-Active Computer Network Defense and Information Assurance; Fast Magic; and NRL Space.

In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance (ISR); Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).

**B. Accomplishments/Planned Program (\$ in Millions)**

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology		PROJECT 2919: Communications Security	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY  The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities, using either GPS systems, non-GPS navigation devices, or atomic clocks. This project will increase the operational effectiveness of U.S. Naval units. Emphasis is placed on (a) GPS Anti-Jam Technology, (b) Precision Time and Time Transfer Technology and (c) Non-GPS Navigation Technology (Inertial aviation system, bathymetry, gravity and magnetic navigation). The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS). The current specific objectives are:  a) GPS Anti-Jam Antennas and Receivers: Develop/demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; develop, demonstrate and transition anti-spoofers/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats.  b) Precision Time and Time Transfer: Develop/evaluate/demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; Develop/demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time.  c) Non-GPS Navigation Technology: Develop/demonstrate an advanced inertial navigation system for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; Develop, demonstrate and transition a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals.	3.886	0.000	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.</p> <p>This activity transfers to PE 0603271N in FY 2010.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>GPS Anti-Jam (AJ) Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Completed the development of Enhanced AJ GPS Receiver Technology.</li><li>- Completed the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project.</li></ul> <p>Precision Time and Time Transfer:</p> <ul style="list-style-type: none"><li>- Completed the GPS Synchronization of a Chip-scale Atomic Clock project.</li><li>- Completed the Qualification of a Commercial-Off-The-Shelf Miniature Atomic Clock project.</li></ul> <p>Non-GPS Navigation Technology:</p> <ul style="list-style-type: none"><li>- Completed the development of Integrated Optically Transduced Gyro Assembly project.</li><li>- Completed the development of Scaleable Integrated Micro Optical Gyroscope project.</li><li>- Completed the development of Navigation Grade Microfabricated Integrated Optical Gyro project.</li><li>- Completed the development of Navigation Grade Sub-Harmonic Lateral Mode Gyro project.</li><li>- Completed the Simultaneous Localization and Mapping Inertial Measurement Unit non-GPS Navigator project.</li></ul> <p>In addition to being performed here in FY 2009, the following efforts transfer to PE 0603271N in FY 2010:</p> <p>GPS Anti-Jam Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Continued the Adaptive Temporal Suppression of GPS Structured Interference project.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued the GPS anti-spoofers antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system.</p> <p>Precision Time and Time Transfer:</p> <p>- Continued the development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO).</p> <p>Non-GPS Navigation Technology:</p> <p>- Continued the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer.</p> <p>- Continued the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.</p> <p>- Continued the MEMS Gyro-cluster INS for Tactical Platforms project.</p> <p>- Continued the Precision Celestial Navigation System (PCNS) project.</p> <p>- Continued the Dead Reckoning Advanced Tight Coupling (DRATC) project.</p> <p>- Continued the navigation grade Inertial Navigation System (INS) using fiber optic/MEMS gyros and electro-optic accelerometers.</p> <p>- Initiated the development of the Sonar Aided Bathymetric Navigation Technology.</p> <p>- Initiated the Optically Transduced MEMS Inertial Navigation System project.</p> <p>- Initiated the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project.</p> <p>- Initiated the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project.</p>					
HIGH-INTEGRITY GLOBAL POSITIONING SYSTEM (HIGPS)  The High-Integrity Global Positioning System (HIGPS) activity is focused on developing the technology required to demonstrate the capability of using the existing Iridium satellite constellation to enhance current GPS navigation and timing capabilities. Enhancements include improved anti-jam performance,	48.445	56.151	40.911	0.000	40.911

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
improved accuracy of navigation and positioning, increased availability of satellite navigation signals, improved accuracy in time stability transfer, and faster acquisition times.						
This activity focuses on integrating a HIGPS Enabling Technology Development (ETD) prototype. This effort is planned to transition to a HIGPS Technology Concept Demonstration (TCD) program under Navy program management at Office of Naval Research.						
The increase from FY 2009 to FY 2010 is required for procurement of prototype user equipment and completion of HIGPS technology demonstrations in FY 2009.						
The decrease from FY 2010 to 2011 is due to the completion of research and demonstration activities for the HIGPS TCD project.						
FY 2009 Accomplishments: - Continued the HIGPS TCD project. The HIGPS project continued using the HI GPS ETD as a foundation to assemble a system that will demonstrate the GPS augmentation concept. In FY 2009 the activity was concerned with the system demonstration using Iridium ephemeris store and broadcast, precision time and differential GPS aiding from a base station, an enhanced narrowband Iridium signal, and brassboard user equipment.						
FY 2010 Plans: - Continue the HIGPS TCD project.						
FY 2011 Base Plans: - Complete the HIGPS TCD project.						
INFORMATION SECURITY RESEARCH		1.902	1.698	1.840	0.000	1.840

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The overarching objective of this activity is to protect the Navy and the Joint information infrastructure from hostile exploitation and attack. The current specific objectives are:</p> <p>a) Network Situation Awareness &amp; Security: Develop tools, techniques and methodologies to improve network resistance to denial of service attacks and improve indications and warnings of suspect activities.</p> <p>b) Network Traffic Analysis and Assessment: Develop methods for conducting network traffic analysis; monitoring and assessing network status and health; identifying new capabilities to analyze network vulnerabilities and attacks; and providing situational awareness of network assets and operations.</p> <p>c) Information Assurance: Develop and measure the effectiveness of Information Assurance (IA) protective solutions and improve the quality and level of certification of information assurance software.</p> <p>The decrease between FY 2009 and FY 2010 was due to an increased level of effort on a one time basis during FY 2009 to support Information Security Research associated with software programmable payload opportunities.</p> <p>The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>Network Situation Awareness &amp; Security:</p> <ul style="list-style-type: none"><li>- Continued development of a tool for the development of agents that integrates UML and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers.</li></ul> <p>Network Traffic Analysis and Assessment:</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued development of the security management tool that provides a common picture of the networked environment with respect to IA and security, with emphasis on visualization capabilities to support active computer network defense.</p> <p>- Continued the development of capabilities and an infrastructure that will support the management of high assurance devices/components used within Navy networks. Ensured the approach was supported by the Navy's network centric architecture.</p> <p>Information Assurance:</p> <p>- Continued the development of a tool suite that will provide evidence of assurance for security products based on the foundations of formal methods. The tool will provide the automated analysis of the implementation based on the security policy, the architecture and/or the software security critical functions.</p> <p>- Completed the development of integrated capabilities that support battle damage assessment and infrastructure and asset protection based on information provided by the common picture of the networked environment with respect to IA and security.</p> <p><i>FY 2010 Plans:</i></p> <p>Network Situation Awareness &amp; Security:</p> <p>- Continue all efforts of FY 2009.</p> <p>- Complete a tool for the development of agents that integrates unified modeling language (UML) and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers.</p> <p>- Initiate new high assurance security protocols for networks and communications infrastructure with particular emphasis on attack resistance and security management.</p> <p>Network Traffic Analysis and Assessment:</p> <p>- Continue all efforts of FY 2009.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Information Assurance: - Continue all efforts of FY 2009 less those noted as completed above. - Complete a tool suite that will provide evidence of assurance for security products based on the foundations of formal methods that will provide the automated analysis of the implementation based on the security policy.  FY 2011 Base Plans: Network Situation Awareness & Security: - Continue all efforts of FY 2010 less those noted as completed above.  Network Traffic Analysis and Assessment: - Complete development of the security management tool that provides a common picture of the networked environment with respect to IA and security, with emphasis on visualization capabilities to support active computer network defense. - Complete the development of capabilities and an infrastructure that will support the management of high assurance devices/components used within Navy networks. Ensure the approach is supported by the Navy's network centric architecture.  Information Assurance: - Continue all efforts of FY 2010 less those noted as completed above. - Initiate enclave boundary security controller to protect Navy networks from attack and exploitation with emphasis on addressing malware, detection, data exfiltration, general attack detection, network reconstitution, exploitable cross-infrastructure dependencies.						
KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA)  A portion of this activity is devoted to mid-term technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition programs of record. This activity area also appears in PE 0602235N. The		32.350	45.089	53.969	0.000	53.969

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
aspects of a given EC in PE 0602235N focus on component technology, while this PE focuses on the integration of the components and on demonstrations. Warfighter Capability Gaps are being addressed by EC's. Each EC delivers capability-level products to acquisition in a three to five-year effort, and allocates a sufficient investment to ensure a capability is provided.						
The Future Naval Enabling Capabilities in this activity span across the Information Infrastructure, Applications/Tools/Decision Aids, Command and Control, Apertures and Radios, and Tactical Networks and Network Control/Management, and Computer Network Defense and Information Assurance technology areas. Technologies being developed will integrate sensors, networks, decision aids, weapons and supporting systems into a highly adaptive, human-centric, comprehensive maritime system. This system will operate from the sea bed to space in a Service Oriented Architecture (SOA) that can be used in a Joint Environment. To accomplish this information integration, efforts are underway to develop rapid, accurate decision making and dynamic, efficient, mission-responsive communications and networks. Objectives of the current ECs are:						
a) COCOM to Marine Combat ID: Develop technologies that enable all Naval forces to quickly obtain and exchange Blue Force information and provide global synchronization tools in an Service Oriented Architecture (SOA).						
b) Combat ID Information Management of Coordinated Electronic Surveillance: Develop capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems. Demonstrations will be conducted in an operational Sea Trial environment. The benefits to the war-fighter include: More effective use of tactical sensors to maintain track and identify consistent with Commander's priorities; tactical sensor resources allocated effectively to complement						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Intelligence coverage; reduction in exposure of friendly forces to hostile action; order of magnitude reduction to false recognition and improper identification of significant military entities consistent with sensor capabilities; SOA enabled applications and infrastructure.						
c) Combat ID in the Maritime Domain to Reveal Contact Intent: Develop an automated capability to understand and interpret relationships among objects in the context of the maritime environment to include threat prediction and intent as well as event outcome assessment. Benefits to the Naval decision-maker include: automated interpretation of asset relationships and threat/impact assessment; automated processing over wide disparate datasets; recognition of anomalies, and proactive means to confirm or discount suspicious activity; framework extension of fusion to a real-time SOA enterprise environment.						
d) Automated Control of Large Sensor Networks: Develop a capability for automated and mission specific tactical sensor fields capable of fulfilling specific mission objectives with smart sensors that are capable of forwarding knowledge vice raw data. Technical development efforts also include a fusion engine capable of translating tactical sensor data into appropriate situational awareness for battalion level forces and below. Integration of the tactical sensor network with Distributed Common Ground System (DCGS) will assure that fusion, visualization, resource management and information dissemination engines run seamlessly from the individual Marine to the Commander, Joint Task Force (CJTF).						
e) OCO Focused Tactical Persistent Surveillance: Develop a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to OCO. This includes organic sensors for small tactical expeditionary units, capable of supporting the dynamic character of modern operations from the highly mobile to the long-term. Also, Tracking, Tagging and Locating (TTL) technical development of Quantum dot, Electro-Optic (EO) phase shifted and optical tags for use against vehicles and high priority entities. Finally the effort includes technical development to enhance						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
tactical sensor communications for a two-way high data rate radio. Technology allows for automatic adaptation of waveforms for increased network capacity.						
f) Globally Netted Joint/Coalition Force Maritime Component Commander: Develop 'globally-networked, theater-focused' maritime capabilities to enhance Joint Task Force (JTF) and COCOMs' ability to execute their intentions. The efforts will support multiple users and multiple roles to access data at any command echelon; provide consistent, qualified, and traceable operational & tactical maritime information across theaters; provide pedigree to provide a clear representation of complex situation and threat elements; supports user interaction across the SOA environment. The benefits to Naval forces include: exploitation of navy presence FORWARD to monitor vessels, people, cargo and designated missions, areas of interest within the global maritime environment; access to all relevant databases; and collection, analysis, and dissemination of relevant information.						
g) Dynamic Tactical Communications Networks: Develop, integrate and demonstrate dynamically adaptive automated software algorithms, protocols, and network management techniques that provide a rapidly auto-configuring and self-organizing networking capability. This capability will adapt to available links of opportunity at lower echelons and assure priority movement of critical data intra-network and through reachback gateway networks that interface with the Global Information Grid (GIG) across multiple security/routing domains. Benefits of this effort to the war-fighter include: timely exchange of situational awareness and C2 information for the Naval Expeditionary Combatant forces; high throughput tactical network access/delivery, SOA and coalition interoperability through a reliable communications grid; ad-hoc re-tasking and targeting of warriors, weapons and sensors with minimum human intervention; shortened kill chain for tactical engagement missions.						
h) Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): Develop a capability that will provide the maritime commander with agile and responsive control and management of tactical Anti-Submarine Warfare (ASW) interactions in a net-centric enterprise environment. Focus will address						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
classified ASW requirements for command and control at the tactical level. Benefits to Naval forces include flexible command and control among tactical units with severely degraded communications with the Maritime Operations Center.						
i) High-bandwidth Free-space Laser Communication (Lasercomm): Develop an affordable, reliable and high-bandwidth Free-Space Lasercomm capability which is adaptive and agile in mitigating a wide range of atmospheric and sea surface/state turbulence, precipitation and obscuration conditions. Benefits include real-time high-bandwidth direct ship-ship, ship-air and ship-shore links in RF denied environments; enhanced reachback for Forward Operating Bases (FOB) to Marine expeditionary Command Operation Centers (COC) with limited SATCOM access; and biometrics information sharing between Marine Interdiction Operation (MIO) parties.						
j) Actionable Intelligence Enabled by Persistent Surveillance: Develop a capability to provide accurate threat detection by exposing the enemy's vulnerabilities, unmasking their latent networks, discovering their tactics, techniques, procedures and exploiting in new ways the vast amount of sensor data available today against an irregular threat. Also being developed: an electro-optical, infrared and laser Intelligence, Surveillance, and Reconnaissance Targeting (ISRT) optics technology, capable of wide Field of View/Field of Range (FOV/FOR) at variable resolution & pointing direction, for installation in mobile platforms without gimbals; a light weight, low cost sensor suite and autonomy algorithms to enable detection and avoidance of all classes of aircraft or Unmanned Aerial Vehicles (UAV).						
k) Pro-Active Computer Network Defense and Information Assurance: Develop a capability to 1) identify and counter real-time threats to the network during mission execution; 2) provide dynamic security management and component management of network-based assets to support mission execution; and 3) ensure mission essential capabilities and data exist despite malicious cyber actions. Specific efforts include: 1) Next Generation Sensors and Gateways to provide security and control mechanisms to protect networks, data and systems from attacks (e.g., malicious code, data exfiltration);						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
2) Next Generation Security Protocols and Security Management Protocols to provide hardened, highly survivable, stealthy, reconfigurable overlay of protocols onto networks to ensure network-base configuration and control of security components essential to mission operations, as well as provide data provenance to support dynamic resource management and decision support; and 3) Common Operational Security Decision System to aggregate, correlate, fuse and visualize network security posture information to support integrated warfighting decisions.						
l) Fast Magic: Develop a capability for enabling Information Operations from tactical platforms in a net-centric environment. Details are classified.						
m) NRL Space: Develop a capability to integrate multiple sensor information from multiple net-centered data stores in a service oriented architecture environment for persistent vessel tracking situational awareness. Details are classified.						
The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
The increase from FY 2009 through FY 2010 is due to the initiation of 5 new FNC ECs and to the expansion of investment within ECs which will commence in FY 2009. New EC initiations for FY 2010 include: Free-space Optical Terminal (FOT), Modulating Retro-reflector Unit (MRU), Autonomous UAV Collision Avoidance System, Operational Adaptation Enterprise Services, and Ultra Wide FOV Area Surveillance System. The FY 2010 shift in FNC investment within 0603235N is consistent with overall program objectives and maturation of research initiatives within this PE. FNC program investment remains consistent with prior year plans and Navy objectives and approval.						
The increase from FY 2010 to FY 2011 is associated with the following:						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate three new FNC Enabling Capabilities (ECs): Pro-Active Computer Network Defense and Information Assurance, Fast Magic, and NRL Space.</p> <p>- Continue ramp up of ongoing EC efforts: High-bandwidth Free-space Lasercomm, GWOT Focused Tactical Persistent Surveillance, Globally Netted Joint/Coalition Force Maritime Component Commander, Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC), Actionable Intelligence Enabled by Persistent Surveillance, and FNC Common Picture Technology.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>COCOM to Marine Combat ID:</p> <p>- Completed the Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide GIG-compliant core enterprise Services and Community of Interest (COI) Services which will ensure warfighting COIs access to information required from any source for rapid situation awareness assessment.</p> <p>Combat ID Information Management of Coordinated Electronic Surveillance:</p> <p>- Initiated the development of software that will provide the capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance &amp; reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems.</p> <p>- Initiated the development and demonstration of the service oriented network-centric architecture for adapting multi-sensor fusion and adaptive resource management across a network of intelligence sensors in an operational (Sea Trial) environment.</p> <p>Combat ID in the Maritime Domain to Reveal Contact Intent:</p> <p>- Continued the development of algorithms and software that will provide an automated capability to understand and interpret relationships among objects in the context of the maritime environment to include threat prediction and intent as well as event outcome assessment.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
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<p>- Continued the development and demonstration of software that provides the capability to extract anomalies and provide basic reasoning techniques to separate false alarms from true anomalies. Tests will be conducted in both Limited Technology Experiments and Sea Trials.</p> <p>- Continued the development and demonstration of smart algorithms for each sensor type that enables the translation of signals to information at the node; tactical multi-INT fusion algorithms; enhancements allowing for the fusion of tactical and higher sourced data and for the combined translation of information to actionable intelligence; and a tactical service oriented architecture.</p> <p>Automated Control of Large Sensor Networks:</p> <p>- Continued the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications and warnings based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node.</p> <p>- Initiated the development, integration and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload, tactical RF sensors, sensors to sense the state of a person and smart tactical imagers and acoustic sensors; of novel high bandwidth communications links for tactical UAVs and battery powered high information content tactical sensors; and airborne readers of optical tags.</p> <p>OCO Focused Tactical Persistent Surveillance:</p> <p>- Continued the development of a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to overseas contingency operations. This includes organic sensors for small tactical expeditionary units, technical development of Quantum dot, Electro-Optic (EO) phase shifted and optical tags for use against vehicles and high priority entities, and technical development to enhance tactical sensor communications for a two-way high data rate radio.</p> <p>Globally Netted Joint/Coalition Force Maritime Component Commander:</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued development of technology to enable the coordinated Global Joint and Coalition Force Maritime Component Commander (J/CFMCC) capture and share information from sources and processes; with the intended result of managing at least 10,000 tracks per day in a consistent manner to support user awareness and control (current capability is approximately 200 tracks per day globally).</p> <p>- Initiated the development, integration, and demonstration in Sea Trials the near real time ability to access all relevant databases and collect, analyze and disseminate relevant information to Maritime Component Commanders.</p> <p>Dynamic Tactical Communications Networks:</p> <p>- Initiated effort to develop and apply emerging technologies that support self-organizing networking and assured communications exchange in tactical communications networks.</p> <p>- Initiated development, integration and demonstration of wireless network auto-configuration and self-organization (including dynamic partitions and merge) algorithms and protocols; distributed and dynamic policy based network management and secure mobility management solutions; network service discovery mechanisms and network-aware middleware-enabled applications; inter-domain (security and routing) protocols for fully-connected domains; and robust and bandwidth efficient group communication protocols for the tactical environment, including disruption tolerance.</p> <p>Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC):</p> <p>- Initiated effort to mature, demonstrate and apply emerging technologies that support dynamic and response management and control of net-centric enterprise theater and tactical ASW operations. This includes automation support for synchronized planning of resources and multi-mission execution, and access and shared awareness of data, activities and status among Maritime Operation Centers and tactical forces in a tactical netted SOA environment.</p> <p>- Initiated the development, integration and demonstration of SOA tactical services that support C2 by providing decision-quality information to the commander much more rapidly than in the past, and in response to unanticipated changes in operational requirements using data management</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>with disconnected, intermittent, or limited communications paths; shared awareness of track data; adaptation to network conditions; and automated and real-time composition of existing tactical enterprise services to accomplish a new C2 function.</p> <p>- Initiated the development and demonstration of automated techniques for force planning and allocation of resources based on information as it is passed from the Operational Level MOC to the local-tactical level and from local-tactical centers to adjacent local-tactical centers.</p> <p>Acquisition Workforce Fund</p> <p>- Funded DoD Acquisition Workforce Fund.</p> <p><i>FY 2010 Plans:</i></p> <p>Combat ID Information Management of Coordinated Electronic Surveillance:</p> <p>- Complete the development of software that will provide the capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance &amp; reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems.</p> <p>- Complete the development and demonstration of the service oriented network-centric architecture for adapting multi-sensor fusion and adaptive resource management across a network of intelligence sensors in an operational (Sea Trial) environment.</p> <p>Combat ID in the Maritime Domain to Reveal Contact Intent:</p> <p>- Continue all efforts of FY 2009.</p> <p>Automated Control of Large Sensor Networks:</p> <p>- Continue all efforts of FY 2009.</p> <p>- Continue the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology		PROJECT 2919: Communications Security		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
and warnings based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node. Tests will be conducted in an Advanced Warfighting Experiment during FY 2010.						
OCO Focused Tactical Persistent Surveillance: - Continue all efforts of FY 2009. - Initiate development, integration, and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload and an RF payload for a tier-2 UAV. - Initiate development, integration, and demonstration of a distributed architecture of smart metadata and analysis tools.						
Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2009.						
Dynamic Tactical Communications Networks: - Continue all efforts of FY 2009.						
Dynamic C2 for Tactical Forces and MOC: - Continue all efforts of FY 2009.						
High-bandwidth Free-Space Lasercomm: - Initiate the development of software/hardware for mitigation techniques for laser beam propagation through atmospheric turbulence and aerosol obscuration; fast acquisition and fine beam steering/tracking algorithms; characterization of performance/affordability of mechanical steering to not-so-mature electronic steering approaches under the Adaptive Photonic Phase-Locked Elements (APPLE) program. - Initiate the development of wide-area avalanche photo-diode receive array techniques; high bandwidth wide field-of-view retro-reflector optics; and adaptive bit rate and transmit power control.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology		PROJECT 2919: Communications Security		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate the development and integration of turbulence mitigation techniques to dual-mode free-space optical terminal electronics/optics.</p> <p>- Initiate the development and demonstration of adaptive bit rate (10 Mbps-1 Gbps) and transmit power control; wide-area avalanche photo-diode receive array technique; high bandwidth wide field-of-view retro-reflector optics.</p> <p>- Initiate the development of platform specific (e.g., P3/E2-C or ship or sub periscope mount) terminal configuration and 'disadvantaged platform' specific retro-reflector configuration.</p> <p>Actionable Intelligence Enabled by Persistent Surveillance:</p> <p>- Initiate development, integration and demonstration of an active liquid crystal lens for a very high resolution focal plane array, a distributed architecture of smart meta data and analysis tools, and control laws that allow a tier-2 UAV to satisfy flight safety standards required in manned airspace.</p> <p><i>FY 2011 Base Plans:</i></p> <p>Combat ID in the Maritime Domain to Reveal Contact Intent:</p> <p>- Complete the development of algorithms and software that will provide an automated capability to understand and interpret relationships among objects in the context of the maritime environment to include threat prediction and intent as well as event outcome assessment.</p> <p>- Complete the development and demonstration of software that provides the capability to extract anomalies and provide basic reasoning techniques to separate false alarms from true anomalies. Tests will be conducted in both Limited Technology Experiments and Sea Trials.</p> <p>- Complete the development and demonstration of smart algorithms for each sensor type that enables the translation of signals to information at the node; tactical multi-INT fusion algorithms; enhancements allowing for the fusion of tactical and higher sourced data and for the combined translation of information to actionable intelligence; and a tactical service oriented architecture.</p> <p>Automated Control of Large Sensor Networks:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology		PROJECT 2919: Communications Security		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Complete the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications and warnings based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node.</p> <p>- Complete the development, integration and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload, tactical RF sensors, sensors to sense the state of a person and smart tactical imagers and acoustic sensors; of novel high bandwidth communications links for tactical UAVs and battery powered high information content tactical sensors; and airborne readers of optical tags. Tests will be conducted in an Advanced Warfighting Experiment.</p> <p>OCO Focused Tactical Persistent Surveillance:</p> <p>- Continue all efforts of FY 2010.</p> <p>Globally Netted Joint/Coalition Force Maritime Component Commander:</p> <p>- Continue all efforts of FY 2010.</p> <p>Dynamic Tactical Communications Networks:</p> <p>- Continue all efforts of FY 2010.</p> <p>Dynamic C2 for Tactical Forces and MOC:</p> <p>- Continue all efforts of FY 2010.</p> <p>High-bandwidth Free-space Lasercomm:</p> <p>- Continue all efforts of FY 2010.</p> <p>Actionable Intelligence Enabled by Persistent Surveillance:</p> <p>- Continue all efforts of FY 2010.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology		PROJECT 2919: Communications Security		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Pro-Active Computer Network Defense and Information Assurance: - Initiate the development, integration and demonstration of Next Generation Sensors and Gateways to provide security and control mechanisms to protect networks, data and systems from attacks (e.g., malicious code, data exfiltration.) - Initiate the development, integration and demonstration of Next Generation Security Protocols and Security Management Protocols to provide hardened, highly survivable, stealthy, reconfigurable overlay of protocols onto networks to ensure network-base configuration and control of security components essential to mission operations, as well as provide data provenance to support dynamic resource management and decision support. - Initiate the development, integration and demonstration of Common Operational Security Decision System to aggregate, correlate, fuse and visualize network security posture information to support integrated warfighting decisions.  Fast Magic: - Initiate the development of algorithms and demonstration of technologies and software for enabling Information Operations from tactical platforms in a net-centric environment. Details are classified.  NRL Space: - Initiate the development of multiple intelligence fusion algorithms and software for dynamic distributed computing environments. Demonstrate the capability to integrate multiple sensor information from multiple net-centered data stores in a service oriented architecture environment for persistent vessel tracking situational awareness.						
Accomplishments/Planned Programs Subtotals		86.583	102.938	96.720	0.000	96.720

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603235N: Common Picture Advanced Technology				PROJECT 2919: Communications Security			
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0602235N: COMMON PICTURE APPLIED RESEARCH	27.585	26.752	34.334	0.000	34.334	27.318	15.424	7.179	2.185	0.000	140.777
D. Acquisition Strategy N/A											
E. Performance Metrics											
<p>This PE supports the development of technologies that address the advanced technology development, test, and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.</p> <p>Specific examples of metrics under this PE include:</p> <ul style="list-style-type: none"><li>- Enable the coordinated Global Joint and Coalition Force Maritime Component Commander to capture and share information from sources and processes with the intended result of managing at least 10,000 tracks per day in a consistent manner to support user awareness and control (current capability is approximately 200 tracks per day globally).</li><li>- Enable faster planning of assets allocated to fill ISR coverage gaps by 100 times; 100 percent more coverage or 50 percent reduction in sensor asset usage to enable more effective allocation of assets to eliminate redundant ISR coverage; 95 percent of all significant military objects correctly located, tracked and identified.</li><li>- Enable self-organizing tactical communication networks by increasing multimember network size from 20 nodes to 200 nodes; decreasing time for networks auto-configuration from hours to five minutes for 200 nodes; and decreasing time for individual entities to join or leave a network from minutes (often hours) to 10 seconds.</li></ul>											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010												
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603235N: <i>Common Picture Advanced Technology</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>												
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>									
9999: <i>Congressional Adds</i>	0.000	1.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.970									
<p><b><u>A. Mission Description and Budget Item Justification</u></b> Congressional add.</p> <p><b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b></p> <table border="1" style="width:100%; border-collapse: collapse; margin-top: 20px;"> <tr> <td style="width: 60%;"></td> <td align="center"><b>FY 2009</b></td> <td align="center"><b>FY 2010</b></td> </tr> <tr> <td>Congressional Add: 4D Data Fusion Visualization <i>FY 2010 Plans:</i> This effort supports 4-D Data Fusion Visualization research.</td> <td align="center">0.000</td> <td align="center">1.593</td> </tr> <tr> <td align="right">Congressional Adds Subtotals</td> <td align="center">0.000</td> <td align="center">1.593</td> </tr> </table> <p><b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A</p> <p><b><u>D. Acquisition Strategy</u></b> N/A</p> <p><b><u>E. Performance Metrics</u></b> Congressional add.</p>													<b>FY 2009</b>	<b>FY 2010</b>	Congressional Add: 4D Data Fusion Visualization <i>FY 2010 Plans:</i> This effort supports 4-D Data Fusion Visualization research.	0.000	1.593	Congressional Adds Subtotals	0.000	1.593
	<b>FY 2009</b>	<b>FY 2010</b>																		
Congressional Add: 4D Data Fusion Visualization <i>FY 2010 Plans:</i> This effort supports 4-D Data Fusion Visualization research.	0.000	1.593																		
Congressional Adds Subtotals	0.000	1.593																		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603236N: Warfighter Sustainment Advd Tech							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	110.904	92.864	98.261	0.000	98.261	92.820	62.799	63.199	60.430	Continuing	Continuing
2915: Warfighter Sustainment Adv Tech	85.613	85.853	98.261	0.000	98.261	92.820	62.799	63.199	60.430	Continuing	Continuing
9999: Congressional Adds	25.291	7.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	112.638
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&amp;T) Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential S&amp;T efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>Warfighter Sustainment Advanced Technology supports: Manpower and Personnel, Training, and Readiness; and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. It supports Future Naval Capabilities (FNC) Programs in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. It develops technologies that enable the Navy to better recruit, select, classify, assign, and manage its people; to train effectively and affordably in classroom settings, in simulated and actual environments, and while deployed; and to effect human systems design into weapon systems. Other technologies enable reduced operating costs through life-extension of legacy systems and increased efficiency of future propulsion systems and improved diagnostic tools.</p>											
<p>Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of: Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Sub Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		PE 0603236N: Warfighter Sustainment Advd Tech			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	137.458	86.239	0.000	0.000	0.000
Current President's Budget	110.904	92.864	98.261	0.000	98.261
Total Adjustments	-26.554	6.625	98.261	0.000	98.261
• Congressional General Reductions		-0.386			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.029			
• Congressional Adds		7.040			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-23.529	0.000			
• SBIR/STTR Transfer	-3.025	0.000			
• Program Adjustments	0.000	0.000	98.261	0.000	98.261
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Intelligent Retrieval of Imagery				0.000	1.992
Congressional Add: Marine Corps Cultural and Language Training Platform				0.000	0.637
Congressional Add: Nanofluidic Lubricants for Increased Fuel Efficiency in Heavy Duty Vehicles				0.000	1.195
Congressional Add: Defense Modernization and Sustainment Initiative				4.986	0.000
Congressional Add: Intelligent Work Management for Class Squadrons (C				1.995	0.000
Congressional Add: Environmentally-Sealed, Ruggedized Avionics Displ				3.988	3.187
Congressional Add: Chafing Protection System				1.197	0.000
Congressional Add: Desktop Virtual Trainer Follow-On				2.394	0.000
Congressional Add: Domain Specific Knowledge Capture Interface				1.356	0.000
Congressional Add: Predicting Bio-Agent Threat Profiles using Automat				1.596	0.000
Congressional Add: Sea Base Mobility and Interfaces				4.986	0.000

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603236N: <i>Warfighter Sustainment Advd Tech</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>System for Intelligent Task Assignment &amp; Readiness</i>		0.798	0.000
Congressional Add: <i>Validation of Lift Fan Engine Systems</i>		1.995	0.000
Congressional Add Subtotals for Project: 9999		25.291	7.011
Congressional Add Totals for all Projects		25.291	7.011
<b><u>Change Summary Explanation</u></b>			
Technical: FY 2009 and out reflects a correction to the Seabasing INP funding profile to be consistent with the changes in complexity and cost associated with going from preliminary design and model development through prototype fabrication.			
Schedule:			
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603236N: <i>Warfighter Sustainment Advd Tech</i>				<b>PROJECT</b> 2915: <i>Warfighter Sustainment Adv Tech</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2915: <i>Warfighter Sustainment Adv Tech</i>	85.613	85.853	98.261	0.000	98.261	92.820	62.799	63.199	60.430	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

Warfighter Sustainment Advanced Technology supports Manpower and Personnel, Training, and Readiness; and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. This project supports FNC Programs in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. This project develops technologies that enable the Navy to better recruit, select, classify, assign, and manage its people; to train effectively and affordably in classroom settings, in simulated and actual environments, and while deployed; and to effect human systems integration into weapon systems. Other technologies enable reduced operating costs through life-extension of legacy systems, increased efficiency of future propulsion systems and improved diagnostic tools. Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Submarine Warfare (ASW) required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>AIRFRAME/SHIP CORROSION/COST REDUCTION TECHNOLOGIES</b>	2.472	4.829	9.662	0.000	9.662
<p>This activity includes an integrated approach for the control of the effects of external and internal corrosion in Naval weapon systems as well as cost reduction technology efforts. The work develops advanced, cost effective prevention and lifecycle management technologies. This is particularly significant to life extension for the aging fleet.</p> <p>The funding increase from FY 2009 to FY 2011 is due to the initiation and ramp-up of several new EC's including corrosion related signature technologies and advanced shipboard water desalination and corrosion.</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603236N: Warfighter Sustainment Advd Tech		PROJECT 2915: Warfighter Sustainment Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued Nondestructive Inspection (NDI) technology for heat damage detection on composite materials. - Continued development on improved non-skid coatings. - Continued development on improved ship rudder coatings. - Continued development on high performance topside coatings - Continued development on high performance airfield pavements. - Initiated evaluation of advanced material coatings for erosion control on helicopter main rotor blade leading edges.						
FY 2010 Plans: - Continue all effort of FY 2009. - Complete evaluation of advanced materials for erosion control on helicopter main rotor blade leading edges. - Initiate down select of materials for erosion control of helicopter main rotor blade leading edges for subsystem evaluation of performance. - Initiate evaluation and correlation of materials repair technologies related to sub-system materials for erosion control on helicopter main rotor blade leading edges.						
FY 2011 Base Plans: - Continue all effort of FY 2010, less those noted as completed above. - Initiate systems testing of materials systems for erosion control on helicopter main rotor blade leading edges. - Initiate evaluation, design and demonstration of advanced ASGS (Active Shaft Grounding System) with Condition Based Maintenance (CBM) and signature control. - Initiate evaluation, design, large scale testing and demonstration of Impressed Current Cathodic Protection (ICCP) components.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603236N: Warfighter Sustainment Advd Tech		PROJECT 2915: Warfighter Sustainment Adv Tech	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate evaluation, design and demonstration of dual-use ICCP and novel sensor technology for CBM and closed-loop deamping.</li><li>- Initiate testing and evaluation of diagnostic models and demonstration of materials with improved barrier dielectrics.</li><li>- Initiate evaluation, testing and demonstration of CBM underwater hull analysis model integrated with closed loop deamping model.</li><li>- Initiate development of thermal management system(s) to arrest excessive heat fluxes and loads on amphibious ship by advanced Naval/USMC aircraft.</li></ul>					
FRICION DRAG REDUCTION  This activity is a collaborative effort with the Defense Advanced Research Agency (DARPA) and the Program Executive Officer for Ships (PEO Ships). The objective is to unambiguously demonstrate the performance of large-scale predictive models that incorporate sufficient physics from first-principles models on a large or full-scale ship test vehicle.  FY 2009 funding profile reflects the phased completion of the Friction Drag Reduction program at the end of FY 2009.  FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued design of large-scale demonstrator; modify demonstrator to install drag reduction equipment and sensors.</li><li>- Continued at-sea large-scale demonstrator test.</li><li>- Continued design of an optimal implementation of additive-based drag reduction technology using large-scale predictive models.</li><li>- Completed large-scale flat-plate test and data reduction.</li></ul>	1.234	0.000	0.000	0.000	0.000
HUMAN SYSTEMS DESIGN (FORMALLY INTEGRATION)	4.538	5.996	6.521	0.000	6.521

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603236N: Warfighter Sustainment Advd Tech		PROJECT 2915: Warfighter Sustainment Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
This effort supports the warfighter by providing enhanced capabilities by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention.						
This field of research is paramount to the reduction in complex naval systems design, acquisition, operation, and maintenance costs and improvements in the effectiveness of operations. Congressional, DoD, and Navy policies and instructions require Navy and Marine Corps Program Managers to have a comprehensive plan for Human Systems Design in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the systems. A strong Human Systems Design effort is required to meet these goals.						
The increase in funding from FY 2009 to FY 2010 supports research into mission performance optimization encompassing task centered design and advanced human performance modeling and also research into improving delivery of sensor information to displays for enhanced understanding of uncertain information.						
FY 2009 Accomplishments: - Continued research to develop and demonstrate automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning. - Continued research to develop and demonstrate advanced tactical decision making technologies to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making. - Continued HSI interface display research to improve ships personnel's ability to efficiently and effectively detect, recognize, and identify noisy targets in ambiguous and uncertain dynamic environments.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603236N: Warfighter Sustainment Advd Tech		PROJECT 2915: Warfighter Sustainment Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued HSI tool research, development, and application to engineering efforts to develop robust standardized set of human systems integrated specific modeling and simulation tools to assess the interaction between operators performance by system design by manning levels.</p> <p>- Initiated experiments to study design issues related to simultaneous control and monitoring of a multiple unmanned surface and air vehicles. Of particular importance are issues monitoring and control of multiple vehicles, planning and re-planning as environmental findings from sensors are interpreted, and safety and collision avoidance.</p> <p><i>FY 2010 Plans:</i></p> <p>- Continue all efforts of FY 2009.</p> <p>- Complete HSI interface display research to improve ships personnel's ability to efficiently and effectively detect, recognize, and identify noisy targets in ambiguous and uncertain dynamic environments.</p> <p>- Complete experiments to study design issues related to simultaneous control and monitoring of a multiple unmanned surface and air vehicles.</p> <p>- Initiate research into mission performance optimization encompassing task centered design and advanced human performance modeling for achieving the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet.</p> <p>- Initiate improving the capability to fuse imaging, electronic warfare, inorganic and acoustic sensor inputs into integrated, fused, and intuitive displays that enhance the presentation and command understanding of uncertain information.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all efforts of FY 2010 less those noted as completed above.</p> <p>- Complete research to develop and demonstrate automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning.</p>						

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603236N: Warfighter Sustainment Advd Tech		PROJECT 2915: Warfighter Sustainment Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete research to develop and demonstrate advanced tactical decision making technologies to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making.</li><li>- Initiate developments to incorporate environmental stressors impact(fatigue, motion, vibration and extreme temperatures) into systems engineering tools for the development for complex Navy systems.</li></ul>						
LITTORAL COMBAT  The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/ Marine Corps team to execute the Naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training. The activity includes support to the following FNC ECs; Battlefield Power, Reduced Support Costs 1, Advanced Naval Fires Technology Spiral 1, Combatant Commander (COCOM) to Marine Combat Identification (ID), Global Information Grid (GIG)-Compliant Networking, Hostile Fire Detection and Response Spiral 2, Position-Location-Information, Reduced Cost of Operations 1, Sea Base Collaborative Command and Control, Sea Base Mobility and Interfaces, and Sea Base Integrated Operations.  The increase in funding between FY 2009 and FY 2010 is due to the initial funding of FNC efforts for advanced survivability and mobility for Marine Corps, and the initiation of new FNC efforts to reduce the load of dismounted combatants.  FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued development of battlefield power generation technologies lunchbox sized 500 - 1000W portable JP-8 fueled generator.</li><li>- Initiated development of advanced lighter weight modular individual protective system that will provide increased flexibility and protection for the warfighter. (Concurrent effort funded by PE 0602131M and PE 0603640M).</li></ul>		2.840	9.925	7.664	0.000	7.664

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Continue all efforts of FY 2009. - Continue development and transition advanced power generation technologies that enable reduction of the logistical burden on small tactical units. - Initiate development of advanced armor technologies for improved survivability and advanced suspension technologies for improved cross country mobility of Marine Corps tactical and combat vehicles.(Previous FY 2009 funding by PE 0602131M and 0603640M; concurrent funding by PE 0602131M and PE 0603640M- funding by these PEs completes development and transition). - Initiate development of technologies that will lighten the load of individual warfighters by reducing weight, improving survivability and increasing the mobility of the warfighter.(Concurrent funding provided by PE 0602236N) - Initiate research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification.(Concurrent funding provided by PE 0602236N).						
FY 2011 Base Plans: - Continue all efforts of FY 2010. - Continue development of individual warfighter lightweight protective system technologies that will reduce body armor weight, improve survivability and increase the mobility of the warfighter (lighten the load). - Continue development of technologies that will lighten the load of individual warfighters by reducing weight, improving survivability and increasing the mobility of the warfighter. (Concurrent funding provided by PE 0602131M and PE 0603640M - funding by these PE's completes development and transition). - Continue research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification. (Concurrent funding provided by PE 0602236N), - Complete development and transition advanced power generation technologies that enable reduction of the logistical burden on small tactical units.						
MANPOWER AND PERSONNEL DEVELOPMENT  This activity provides Navy personnel system managers with the ability to attract and retain the right people and to place them in jobs that best use their skills, training, and experience. Application of modeling and simulation, mathematical optimization, advanced testing, statistical forecasting, information visualization, data warehousing, data cleansing, web-based knowledge management, and human performance measurement technologies enhances Fleet readiness and reduces personnel costs.  FY 2009 Accomplishments: - Continued development and demonstration of decision support tools linked with Sea Warrior. - Continued advanced selection, classification and assessment metrics to facilitate optimal labor substitution. - Continued integration and multi-faceted decision support tools to evaluate manpower alternatives. - Continued development and demonstration of behaviorally-based predictive models. - Initiated experiments and demonstration of independent dynamic supply and demand models for Navy skill sets. - Initiated development of a prototype assessment measure of team adaptive performance.  FY 2010 Plans: - Continue all efforts of FY 2009.  FY 2011 Base Plans: - Continue all efforts of FY 2010.		5.016	5.382	4.966	0.000	4.966

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
SEA BASE MOBILITY AND INTERFACES  This activity includes support for Sea Base Mobility and Interfaces and Force Closure. This activity improves the capability for transfer of cargo between Sea Base/Logistics vessels and employment of combat ready forces over unimproved beaches during high sea states. Capabilities being developed include propulsion technologies, maneuvering technologies, and advanced hull systems technologies needed for sustained operations at high speed in high sea states. This activity further supports the Seabasing mission of transporting troops, equipment, and materials from the seabase to shore, and providing support to seaborne forces via surface distribution interfaces.  The reduction between FY 2009 and FY 2010 is due to the completion of the following FNC programs: small to large vessel at sea transfer, high speed seabase to shore connector, high rate horizontal to vertical movement. The transition opportunity for the Axial Flow Waterjet FNC Program has been changed from the Joint High Speed Ship to the Littoral Combat Ship (LCS), a new Technology Transition Agreement (TTA) has been signed. This FNC program is in Phase II where large-scale prototype waterjets will be designed and fabricated for demonstration on the LCS. The reduction between FY 2010 and FY 2011 is due to the completion of FNC BAS-FY06-01, Sea Base Mobility and Interfaces - Specific products are High Rate Vertical/Horizontal Material Movement and Small to Large Vessel At-Sea Transfer Sea Base Connector. FNC EPE-FY07-02, MPF (F) Force, Closure is nearing completion - Specific product is 38 MW Axial-Flow Waterjet.  FY 2009 Accomplishments: - Completed efforts on the High Speed Sea Base to Shore Connector technology development through at-sea demonstrations of the technologies. - Continued work for a beachable high speed craft as a Sea Base mobility interface. - Continued technology exploration in hydrodynamic impacts and design space trade studies. - Continued efforts on the High Speed Sea Base to Shore Connector technology development. - Continued efforts to develop technologies for Small to Large At-Sea Vessel Interfaces.	23.751	6.816	0.698	0.000	0.698

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued the development of concepts for High Rate Horizontal and Vertical Material Movement within the Sea Base.</li><li>- Continued efforts to develop a large scale Axial Flow Waterjet technology with the new transition target to Littoral Combat Ship (LCS).</li><li>- Continued efforts to develop blade control technology for the heavy lift vertical air replacement platform.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete efforts for Small-to-Large Vessel At-Sea Transfer development via an at-sea demonstration of the technology.</li><li>- Complete efforts for High Rate Vertical / Horizontal Material Mover development via a large-scale demonstration of the technology.</li><li>- Initiate efforts to develop large ship fuel savings technologies for high speed materiel transport ships and follow on efforts initiated under Friction Drag Reduction refocused to other FNC efforts.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete efforts on the Axial Flow Waterjet through a large at-sea demonstration of the technology.</li><li>- Initiate development of the Connectors and the Sea Base Enabling Capability consisting of Environmental Ship Motion Forecasting and Advanced Mooring System technologies.</li></ul>						
SEA BASE PLANNING, OPERATIONS AND LOGISTICS  This activity includes support for Sea Base Integrated Operations; Surface Connector Vehicle Transfer; Automated Weapons Assembly; and Sense and Respond Logistics. Sea Basing will require more robust afloat command and control for sustainment activities. Logistics must integrate with the joint task force common operating picture, and provide awareness of mission supportability and readiness at an operational and tactical level. This activity will produce techniques and systems to support		16.786	19.584	20.063	0.000	20.063

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
automated transfer of cargo from shipboard unload/onload point to stowage spaces. This activity further supports the Seabasing mission of marshalling troops, equipment, and materials. It will improve current replenishment capabilities for transfer of cargo between Sea Base/Logistics vessels (large ship-to-ship) during high sea states, while maintaining safety of operations. Technologies include optical recognition, advanced robotics for weapons assembly, integrated data architectures, high-strength composites, wear-resistant coatings, environmental sensing, ship-motion compensation for force control-based systems, intelligent systems, and robotics.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued efforts on the Large to Large Vessel Lift on/Lift off capability.</li><li>- Continued efforts in the development of Interface Ramp Technologies for seabasing.</li><li>- Continued efforts in the development of Intra-Connector Material Handling cargo securing technologies.</li><li>- Continued efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons.</li><li>- Continued the development of advanced technologies to provide a Sense and Respond Logistics capability.</li><li>- Initiated efforts to develop Sense and Respond Logistics Information Architecture prototype.</li></ul> Acquisition Workforce Fund <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete efforts for Intra-Connector Material Handling cargo securing technology development via an at-sea demonstration and transition to NAVSEA PMS 377.</li><li>- Complete efforts on the Large to Large Vessel Interface Lift on/Lift off capability with post-test analyses and transition to NAVSEA PMS385.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete the down selection of the Sense and Respond Logistics Information Architecture.</li><li>- Initiate efforts to demonstrate sensor based Sense and Respond Logistics advanced technologies.</li><li>- Initiate procurement and testing of available microfiltration (MF), and ultrafiltration (UF), systems suitable for shipboard use.</li><li>- Initiate investigation of seawater treatment strategies to optimize performance of MF/UF pretreatment approaches.</li><li>- Initiate procurement and testing of approaches to recover energy from pressurized reverse osmosis waste brine.</li><li>- Initiate efforts to select optimal reverse osmosis membranes.</li><li>- Initiate development of agent based decision support and logistics planning tools.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete efforts on Interface Ramp Technologies development with demonstrations in relevant environments and transition to NAVSEA PMS385.</li><li>- Complete procurement and testing of available MF, and UF, systems suitable for shipboard use.</li><li>- Complete investigation of seawater treatment strategies to optimize performance of MF/UF pretreatment approaches.</li><li>- Complete procurement and testing of approaches to recover energy from reverse osmosis waste brine.</li><li>- Complete efforts to select optimal reverse osmosis membranes.</li><li>- Complete and test first article prototypes of Sense and Respond demonstration systems; Logistics Common Operating Picture, Dexision Support Tool, Prognostics Embedded Health Management, Maco Fuel Quantity Management, Portable Fuel Quantity, Portable Fuel Quality Analysis.</li><li>- Initiate down selection of desired components and begin design of pretreatment system.</li><li>- Initiate down selection of desired energy recovery strategies and reverse osmosis membranes and begin design of reverse osmosis systems.</li></ul>					
SEA BASING	6.542	14.076	29.502	0.000	29.502

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity includes advancement of technologies to support the design and development of Sea Base Enabler Innovative Naval Prototypes (INP's). Areas include design and development of various Sea Basing prototypes in the areas of high speed, shallow draft and beachable connectors; and vessel to vessel interfaces.</p> <p>The Sea Base Enabler INP effort was initiated in FY 2006. The INP program spans from conceptual design through prototype fabrication and testing. This INP plan includes the completion of the development and at-sea testing of the Rapid Deployable Seabasing Stable Transfer Platform demonstrator; the continuation of several land based and tow-tank based model construction and testing for the Sea Base to "Over-the-Shore" Connector Transformational Craft (T-CRAFT) Prototype; and the full scale component-level development, evaluation, and testing of critical T-CRAFT technologies. The increase FY 2009 to FY 2010 is the start of phase III. The increase in FY 2010 to FY 2011 is due to the ship construction and prototype demonstration.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued multiple INP contracts for preliminary designs in the area of a T-CRAFT and a Rapidly Deployable Seabasing Stable Transfer Platform.</li><li>- Continued the down-selection of T-CRAFT designs for further development and model construction and testing.</li><li>- Continued T-CRAFT model construction and testing.</li><li>- Continued a second evaluation of potential new Seabasing INP efforts.</li><li>- Continued planning of T-CRAFT prototype and component development.- Completed T-CRAFT model testing and evaluation.</li><li>- Completed T-CRAFT model testing and evaluation.</li><li>- Initiated the down-selection of T-CRAFT designs for prototype and component development.</li><li>- Initiated testing and evaluation of E-CRAFT demonstrator hydrodynamic and structural characteristics.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Continue all efforts of FY 2009. - Complete the down-selection of T-CRAFT designs for prototype and component development. - Complete testing and evaluation of E-CRAFT demonstrator hydrodynamic and structural characteristics. - Initiate contract design and develop shipyard building plans for T-CRAFT prototype and component construction. - Initiate procurement of components and material to support T-CRAFT prototype construction.					
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Complete contract design and develop shipyard building plans for T-CRAFT prototype and component construction. - Initiate development of a detailed T-CRAFT prototype test and demonstration plan. - Initiate T-CRAFT and component construction.					
TRAINING SYSTEMS  This activity improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable education and training methods and systems. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the logistics, development, delivery, evaluation, and execution of training.  The decrease in funding from FY 2009 to FY 2010 results from completion of research to enhanced human performance in networked environments.  FY 2009 Accomplishments: - Continued research and assessment of advanced gaming technology for enhanced training.	10.946	8.603	8.453	0.000	8.453

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development and demonstration of technology for enhanced human performance in networked environments.</li><li>- Continued developments for enabling better warfighter understanding of languages and cultures to enhance their regional expertise.</li><li>- Initiated advanced technology development demonstrations of game based training for better warfighter understanding of languages and cultures to enhance their regional expertise.</li><li>- Initiated experiments to validate automated performance assessment and after action reviews.</li><li>- Initiated development of an Adaptive Expert System to automatically and rapidly analyze aircrew performance (1M+ flight hours annually) to detect human factors related mishap leading indicators using a new technique with anomaly and corroboration.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete development and demonstration of technology for enhanced human performance in networked environments.</li><li>- Initiate development of validated, effective, adaptive training system components to enhance individual and team training for submarine navigation and piloting skills and for surface ship Combat Information Center training.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Complete research and assessment of advanced gaming technology for enhanced training.</li><li>- Complete experiments to validate automated performance assessment and after action reviews.</li><li>- Initiate the designing, building, demonstration, and evaluation of the efficacy of the technology components/system to deliver combat/tactical profiling relevant perceptual training.</li></ul>						
TURBINE ENGINE TECHNOLOGY		11.488	10.642	10.732	0.000	10.732

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity provides integration and experimental engine testing of advanced gas turbine engine technologies to reduce their technical risk and demonstrate their readiness for transition. These technologies will enable advanced capabilities for Navy weapon systems at reduced total ownership costs. Versatile Affordable Advanced Turbine Engines (VAATE) is a DoD/DOE/NASA/Industry program to develop and demonstrate versatile, affordable, advanced engine technologies enabling for increased systems capabilities and reduced total ownership costs. The VAATE goal is 10X improvement in propulsion system affordability (capability/cost) by 2017, with interim goals of 4X by 2009 and 6X by 2013. The elements of the capability-to-cost index are increased thrust to weight; decreased specific fuel consumption; and reduced development, production, and maintenance costs for the entire integrated propulsion system. To achieve these goals, VAATE is organized into multiple product areas. Specifically for the Navy, the focus, as part of the Enterprise and Platform Enablers FNC, is on turbine engine capability enhancements for future and emerging systems. Technologies critical to Navy fighter jets are being worked, including low pressure turbine technologies for short takeoff and landing; high pressure turbine technologies for higher temperature, longer life; fan and compressor technologies for greater engine robustness and durability, and instrumentation and control technologies for greater engine state awareness and less unscheduled maintenance. Technologies being demonstrated include advanced aerodynamic, material, and structural concepts and emerging active control, prognostic health management, thermal management, aircraft subsystem integration, and information technologies.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued VAATE Phase I: Design, component development, integration and fabrication of Phase I demonstrator engines.</li><li>- Continued development of shipboard compact power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers.</li><li>- Initiated design and fabrication of VAATE Phase II demonstrator engines with GE/LW and P&amp;W. (Impact of Congressional reduction: Planning of VAATE Phase II demonstrator engine with GE/LW has been delayed until FY 2010.)</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)							FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div>- Completed reporting shipboard compact power conversion project under this Program Element (PE). These efforts transition to PE 0603123N Force Protection Advanced Technology, R2 Activity Surface Ship &amp; Submarine Hull Mechanical and Electrical (HM&amp;E) in FY 2009.</div> <div>- Completed testing of VAATE Phase I demonstrator engine with GE/LW.</div> <div>- Initiated component design and development for a VAATE Phase II demonstrator engine with P&amp;W.</div> <div>FY 2010 Plans:</div> <div>- Continue all efforts of FY 2009 less those noted as completed above.</div> <div>- Complete testing of the final VAATE Phase I demonstrator engine with P&amp;W.</div> <div>- Initiate planning of VAATE Phase II demonstrator engine planning with GE/LW.</div> <div>FY 2011 Base Plans:</div> <div>- Continue all efforts of FY 2010 less those noted as completed above.</div>											
Accomplishments/Planned Programs Subtotals							85.613	85.853	98.261	0.000	98.261
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0603640M: USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	0.000	0.809	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.809
• 0602236N: WARFIGHTER SUSTAINMENT APPLIED RESEARCH	27.828	27.809	37.238	0.000	37.238	35.065	19.967	11.237	3.732	0.000	162.876
	0.000	2.353	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.353

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<b>C. Other Program Funding Summary (\$ in Millions)</b>												
	<u>Line Item</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u> <u>Base</u>	<u>FY 2011</u> <u>OCO</u>	<u>FY 2011</u> <u>Total</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
	• 0602131N: <i>MARINE CORPS</i> <i>LANDING FORCE TECHNOLOGY</i>											
<b>D. Acquisition Strategy</b> N/A												
<b>E. Performance Metrics</b> Efforts within this PE support the FNC program and are monitored at two levels. At the lowest level, each is measured against technical and financial milestones on a monthly basis. Annually, each FNC project is reviewed in depth for technical and transition performance by The Chief of Naval Research. Routine site visits to performing organizations are conducted to assess programmatic and technical progress. Most are reviewed annually or bi-annually by an independent board of visitors who assess the level and quality of the Science and Technology basis for the project.												

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603236N: <i>Warfighter Sustainment Advd Tech</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	25.291	7.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	112.638
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Intelligent Retrieval of Imagery <i>FY 2010 Plans:</i> This effort supports Intelligent Retrieval of Imagery research.							0.000	1.992			
Congressional Add: Marine Corps Cultural and Language Training Platform <i>FY 2010 Plans:</i> This effort supports Marine Corps Cultural and Language Training Platform research.							0.000	0.637			
Congressional Add: Nanofluidic Lubricants for Increased Fuel Efficiency in Heavy Duty Vehicles <i>FY 2010 Plans:</i> This effort supports Nanofluidic Lubricants for Increased Fuel Efficiency in Heavy Duty Vehicles research.							0.000	1.195			
Congressional Add: Defense Modernization and Sustainment Initiative							4.986	0.000			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603236N: <i>Warfighter Sustainment Advd Tech</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development of methods to predict and evaluate failure modes for military ground vehicles, ships and aircraft and incorporated technologies and methods to sustain or modernize this equipment to as-built or better condition.		
Congressional Add: Intelligent Work Management for Class Squadrons (C)  <i>FY 2009 Accomplishments:</i> This effort supported the design and development of software enhancements to the Training Readiness Assessment and Management System (TRAMS) and System for Intelligent Task Assignment for Readiness (SITAR). The effort provided two functional capabilities: 1) Implementation of predictive readiness modeling functionality using Discrete Event Simulation and 2) Enhanced work and training management scheduling capabilities to optimize workforce usage according to standards adapted to emerging and immediate fleet needs.	1.995	0.000
Congressional Add: Environmentally-Sealed, Ruggedized Avionics Displ  <i>FY 2009 Accomplishments:</i> This effort supported the development of a display system, performed qualification testing, conducted platform integration tasks, performed certification testing to include thermal, vibration, pressure, and destructive test regimes that qualify the prototype for military use and establish an assembly/integration facility. This project could reduce the manpower currently required for maintenance and cleaning of filters in vertical lift helicopters and unmanned aerial vehicles as a result of harsh combat operational environments.  <i>FY 2010 Plans:</i> Continued support of Environmentally Sealed, Ruggedized Avionics Displays research.	3.988	3.187
	1.197	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Chafing Protection System  <i>FY 2009 Accomplishments:</i> This effort supported the development of a system for the Navy to detect and locate chafing in aircraft wires before electrical arcing occurs (with the possibility of fires developing), resulting in cost-savings and greater safety for Navy personnel.		
Congressional Add: Desktop Virtual Trainer Follow-On  <i>FY 2009 Accomplishments:</i> This effort supported the production of a lookout simulation/training prototype which will train recruits in distance estimation, range estimation, verbal reporting, and the correct handling of a man overboard incident. This effort included testing and refining a game prototype and integration of the game into an existing Navy training system.	2.394	0.000
Congressional Add: Domain Specific Knowledge Capture Interface  <i>FY 2009 Accomplishments:</i> This effort supported the development of Warfighter Sustainment Advanced Technology to capture and operationalize the expertise of naval personnel for use in training exercises. This user centered technology improves warfighter sustainment by providing an architectural framework to create tailored knowledge capture environments.	1.356	0.000
Congressional Add: Predicting Bio-Agent Threat Profiles using Automat  <i>FY 2009 Accomplishments:</i> This effort supported the development of automated behavior analysis models designed to increase the ability to predict bio-agent threat profiles.	1.596	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603236N: <i>Warfighter Sustainment Advd Tech</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Sea Base Mobility and Interfaces  <i>FY 2009 Accomplishments:</i> This effort supported the development of an advanced demonstrator ship capable of transforming itself between a high speed catamaran and shallow draft landing craft in order to connect the sea base with the shore.	4.986	0.000
Congressional Add: System for Intelligent Task Assignment & Readiness  <i>FY 2009 Accomplishments:</i> This effort supported the development and delivery of the System for Intelligent Task Assignment for Readiness (SITAR) which applies automated scheduling technology to find optimal solutions to the complex problems associated with the assignment of maintenance job and training tasks. This is the first automated system to enable the management of fleet sailor readiness. The data available following implementation will greatly improve fleet operational training & readiness.	0.798	0.000
Congressional Add: Validation of Lift Fan Engine Systems  <i>FY 2009 Accomplishments:</i> This effort supported the use of an existing test facility to measure dynamic characteristics of bearings, dampers, splines & clutches and extensively validate key bearing, damper, gear, spline, clutch, and drive shaft models used in PHM software through experimentation. This validation created fleet management tools to be developed and released for implementation.	1.995	0.000
Congressional Adds Subtotals	25.291	7.011

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	R-1 ITEM NOMENCLATURE PE 0603236N: <i>Warfighter Sustainment Advd Tech</i>	PROJECT 9999: <i>Congressional Adds</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603271N: Electromagnetic Systems Advanced Technology							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	56.092	75.506	82.143	14.100	96.243	101.071	105.239	108.364	97.743	Continuing	Continuing
2913: Electromagnetic Systems Advanced Technology	37.144	58.577	82.143	0.000	82.143	101.071	105.239	108.364	97.743	Continuing	Continuing
2933: Wide Focal Planar Array Camera S&T	0.000	0.000	0.000	14.100	14.100	0.000	0.000	0.000	0.000	0.000	14.100
9999: Congressional Adds	18.948	16.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	131.879
A. Mission Description and Budget Item Justification											
The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.											
Activities and efforts in this Program Element (PE) address technologies critical to enabling the transformation of discrete functions to network centric warfare capabilities which simultaneously perform Radar, Electronic Warfare (EW), and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links. The Electromagnetic Systems Advanced Technology program addresses Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems. The Program emphasizes near to mid-term transition opportunities by developing and demonstrating technologies supporting the Future Naval Capabilities (FNC) Program Enabling Capabilities (ECs): Long Range Detection and Tracking, Advanced Electronic Sensor Systems for Missile Defense, Satellite Communication (SATCOM) Vulnerability Mitigation; Affordable Common Radar Architecture, Next Generation Countermeasures Technologies for Ship Missile Defense, Next Generation Airborne Electronic Attack, Low Cost Over the Horizon Communication, SATCOM and Line of Sight (LOS) Apertures, Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms, Countermeasures Technologies for Anti-Ship Missile Defense (ASMD), Global Applications for Data Exfiltration (GLADEX), and Radar Electronic Attack Protection (REAP). Within the Naval Transformational Roadmap, this investment offers affordable options for the transformational capabilities required by the Sea Shield (Theater Air and Missile Defense), Sea Strike (Persistent Intelligence, Surveillance, and Reconnaissance), and ForceNet (Communications and Networking) SeaPower 21 Naval Warfighting Pillars.											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0603271N: Electromagnetic Systems Advanced Technology			
BA 3: Advanced Technology Development (ATD)					
Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	55.866	65.827	0.000	0.000	0.000
Current President's Budget	56.092	75.506	82.143	14.100	96.243
Total Adjustments	0.226	9.679	82.143	14.100	96.243
• Congressional General Reductions		-0.315			
• Congressional Directed Reductions		-7.000			
• Congressional Rescissions	0.000	-0.006			
• Congressional Adds		17.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	1.259	0.000			
• SBIR/STTR Transfer	-1.033	0.000			
• Program Adjustments	0.000	0.000	82.143	0.000	82.143
• Rate/Misc Adjustments	0.000	0.000	0.000	14.100	14.100
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: C BAND ACTIVE ARRAY RADAR					
Congressional Add: PACIFIC AIRBORNE SURVEILLANCE & TESTING					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Technical: FY 2010 reflects the realignment of the Global Positioning System (GPS) & Navigation Technology Activity from PE 0603235N because the technology development efforts are directly related to the current mission of this Program Element.					
Schedule: Not applicable.					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603271N: <i>Electromagnetic Systems Advanced Technology</i>
<p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603271N: <i>Electromagnetic Systems Advanced Technology</i>				<b>PROJECT</b> 2913: <i>Electromagnetic Systems Advanced Technology</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2913: <i>Electromagnetic Systems Advanced Technology</i>	37.144	58.577	82.143	0.000	82.143	101.071	105.239	108.364	97.743	Continuing	Continuing
<b>A. Mission Description and Budget Item Justification</b> This project emphasizes near to mid-term transition opportunities by developing and demonstrating technologies which enable affordable options for transformational capabilities required by the Sea Shield, Sea Strike, and ForceNet pillars. Work in this project addresses cost-effective RF technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<b>ADVANCED MULTI-FUNCTION RF TECHNOLOGY</b>  This effort develops, demonstrates, and transitions affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures capable of transmitting and receiving multiple, simultaneous, independent RF beams while providing reduced signature and numbers of apertures. Program activity goals include development and demonstration of multi functional RF technologies applicable to systems development for Advanced Destroyers (DD(X)), Advanced Cruisers (CG(X)), Aircraft Carriers (CVNs), and other ship classes. These technologies will provide reduced recurring costs for total system functionality; reduced number of topside antennas and support systems; reduced ship radar cross section; reduced number of unique spares and lower ship manning requirements; ability to upgrade systems and capabilities with reduced cost, time, and complexity while mitigating the risk of obsolescence; and ability to rapidly exploit technological innovation through open systems concepts. This activity also includes Multifunction Systems Technology developments that directly support the Department of Defense Joint Warfighter Science and Technology Plan and the Defense Technology Area Plans.  The objective is as follows:						37.144	0.000	0.000	0.000	0.000	

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603271N: Electromagnetic Systems Advanced Technology		PROJECT 2913: Electromagnetic Systems Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Development of an affordable, open architecture Digital Array Radar for CG(X). Development, testing, and technology demonstration of communications, electronic attack, electronic surveillance, and radar functions in multi-function apertures. Development of a Multi Function Electronic Warfare (MFEW)/Electronic Surveillance (ES) Advanced Development Model (ADM) architecture demonstrating key ES capabilities for several simultaneous ES functions and capable of supporting additional RF functions. Conducting MFEW/ES ADM testing that satisfies DD(X) acquisition program Technology Development (TD) phase requirements to enable a smooth transition of AMRF technology to the DD(X) System Development and Demonstration (SDD) Acquisition Phase with minimal changes in system architecture. Electronic Attack (EA) Techniques maintain effective countermeasures in the face of increasingly sophisticated naval threats.						
FY 2009 Accomplishments: In addition to being performed here in FY 2009, the following efforts transfer to the Integrated Topside (INTOP) Innovative Naval Prototype R2 Activity in FY 2010:  - Initiated Integrated Digital Apertures and Array Radar System (IDAARS), a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and provide the appropriate control and synergy of the functionality such that the RF functions automatically support one another providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle to ensure continuing competition for maintenance and replacement parts. - Initiated technical studies of enabling RF components for submarine SATCOM arrays. (Which is a part of the above IDAARS effort.)						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiated SATCOM Array technical designs. (Which is a part of the above IDAARS effort.)</p> <p>- Initiated studies for EA design as follow-on to MFEW capability for forward-fit and back-fit. (Which is a part of the above IDAARS effort.)</p> <p>- Initiated development of architecture and interfaces and their application to wide-band SATCOM communications array for submarines. (Which is a part of the above IDAARS effort.)</p> <p>- Initiated development of functional queue management software. (Which is a part of the above IDAARS effort.)</p> <p>- Initiated development of control interface software for the resource allocation manager. (Which is a part of the above IDAARS effort.)</p> <p>In addition to being performed here in FY 2009, the following efforts transfer to the Electronic and Electromagnetic Systems R-2 Activity in FY 2010:</p> <p>- Continued FNC EC Long Range Detection and Tracking. Captured and extended the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM).</p> <p>- Continued the Next Generation Airborne Electronic Attack effort.</p> <p>- Continued FNC EC Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms. Developed Partial Array consisting of high efficiency non-commercial off-the-shelf (COTS) transmitter element chains using wide band-gap semiconductors, mixed signal digital, RF, microwave, millimeter wave and associated passive components, exploiting Development &amp; Implementation (D&amp;I) advances in high power, high efficiency digital S- and X-band microwave amplifiers to reduce cooling and prime power needs, enabling affordable radar and EA solutions for CG(X) and DD(X). Developed and demonstrated the technology for extending the digital domain further into the transmitter RF hardware, i.e., bringing the digital domain closer to the radiating element, enabling Navy systems to continue to exploit advancements in COTS computing capacity for signal generation and processing, and require the activity to only develop the combined RF/digital hardware. Targeted cost reductions</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to enable ubiquitous deployment of advanced radiating systems with affordable development and procurement costs. This EC takes the lead for development of efficient, high power RF digital-microwave transmitter technology by exploiting new technologies such as Wide Band Gap (WBG) semiconductors for substantial savings of prime power requirements and topside weight and moment. This provides a potential for smaller ships and reduced acquisition and life cycle costs. - Continued H-60 Tactical Common Data Link (TCDL) project. - Continued Low cost SATCOM-on-the-Move array for Marine Corps. - Continued nested, coplanar array/ Modular Integrated Link Electronics System (MILES) design and integration. - Initiated the Affordable Common Radar Architecture (ACRA) effort by defining interface specifications. - Initiated the Enhanced Nulka Payload FNC effort by starting system architecture design. - Initiated the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by starting system architecture design and Low Voltage Gallium Arsenide (GaAs) High Power Amplifier (HPA) Monolithic Microwave Integrated Circuit (MMIC) purchases.  Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund.						
ELECTRONIC AND ELECTROMAGNETIC SYSTEMS  The overarching objective of this activity is to develop, test, and demonstrate communications, electronic attack (EA), electronic surveillance (ES), electronic warfare (EW), and radar functions. This activity also includes development of affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures. A portion of this PE is devoted to mid-term technology development in close concert with acquisition programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition program of record. In this PE, these FNC ECs span across Electronics, EW, Radar, and Communications technology areas. This activity also appears in PE 0602271N. For ECs receiving funding from both PE's, the PE		0.000	33.021	39.124	0.000	39.124

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010				
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B. Accomplishments/Planned Program (\$ in Millions)								
				FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>0602271N portion is generally focused on component design and development while the funding from this PE is focused on integration and demonstration.</p> <p>Effective FY 2010, resources and budget justification associated with the FNC ECs, formerly identified with the ADVANCED MULTI-FUNCTION RF TECHNOLOGY activity, are realigned into this activity. This realignment serves to better describe the full electromagnetic spectrum nature of the research initiatives and improve the tracking and justification of FNC initiatives within the budget submission.</p> <p>The major objectives of this activity are:</p> <p>a) Affordable Common Radar Architecture (ACRA) - Develop a scalable, open radar architecture that addresses affordability challenges for 5 different radars.</p> <p>b) Low Cost Over The Horizon (OTH) Communication, SATCOM and Line Of Sight (LOS) Apertures - Provide apertures, link electronics and programmable terminal components that are suitable for multiple platforms.</p> <p>c) SATCOM Vulnerability Mitigation - Develop a diverse, multi-tier communications networking capability for Naval strike forces.</p> <p>d) Long Range Detection and Tracking - Ability to detect, track and identify (ID) future anti-ship ballistic missiles, advanced cruise missiles, aircraft and Unmanned Air Vehicles (UAVs).</p> <p>e) Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms - Develop and demonstrate affordable components in beamforming element chains for efficient S- and X-Band radar, and EA using highly efficient digital solid state electronics components covering the RF and microwave frequencies.</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603271N: Electromagnetic Systems Advanced Technology		PROJECT 2913: Electromagnetic Systems Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
f) Countermeasure Technologies for Anti-Ship Missile Defense (ASMD) - Improve ship survivability by disrupting the terminal engagement phase of hostile Anti-Ship Cruise Missiles/ Anti-Ship Ballistic Missiles (ASCM/ASBM), including improvements to both onboard Surface Electronic Warfare Improvement Program (SEWIP) and offboard Nulka RF EA systems.						
g) Next Generation Countermeasure Technologies for Ship Missile Defense - Develop and demonstrate the fundamental technologies required to conduct next generation, persistent EW in support of ship, sea base, and littoral force missile defense operations in a distributed, coordinated manner across the entire battlespace.						
h) Next Generation Airborne Electronic Attack - Develop and demonstrate advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide Suppression of Enemy Air Defenses (SEAD), deliver Non-Kinetic Fires, counter Integrated Air Defense Systems (IADS), and provide suppression of Command, Control & Communications (C3) links and data networks.						
i) Global Applications for Data Exfiltration (GLADEX) - Develop a capability for monitoring and relay of unattended sensor data for global situational awareness. Benefits include security through encryption, reduced dependence on commercial systems, and reduced collection needs by manned and unmanned in-area assets. It addresses a shortfall to monitor shipping in territorial waters and the open ocean to combat terrorism, and, enforce criminal law.						
j) Radar Electronic Attack Protection (REAP) - Develop single platform precision passive Electronic Support Measure (ESM) and Electronic Protection (EP) techniques and technology to counter hostile use of modern Electronic Attack (EA) self protection jammers.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>k) Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3 - Develop integrated RF communications and RF jammer capability that addresses the electromagnetic interference (EMI) issue to enable interoperability.</p> <p>The increase from FY 2010 to FY 2011 is due to increased investment supporting research for the JCREW 3.3 effort.</p> <p>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.</p> <p><i>FY 2010 Plans:</i></p> <p>Affordable Common Radar Architecture (ACRA):</p> <ul style="list-style-type: none"><li>- Continue the ACRA effort by defining interface specifications. This effort is developing a radar architecture which moves the digital conversions as close to the antenna as possible for substantial performance and supportability improvements.</li></ul> <p>Low Cost Over The Horizon (OTH) Communication, Satellite Communication (SATCOM) and Line Of Sight (LOS) Apertures:</p> <ul style="list-style-type: none"><li>- Continue H-60 Tactical Common Data Link (TCDL) project. This effort develops a scalable, low cost, light weight, low drag multichannel Jam Resistant (JR) Tactical Common Data Link (TCDL) relay and networking terminal.</li><li>- Continue Low cost SATCOM-on-the-Move array for Marine Corps. This effort develops a low cost, scaleable SATCOM on-the-move communication system for both High Data Rate (HDR) and Low Data Rate (LDR) Marine Corps vehicular communications.</li><li>- Continue nested, coplanar array/Modular Integrated Link Electronics System (MILES) design and integration. This effort develops a communications array which will provide Ultra High Frequency (UHF) LOS functionality and Ku-Band communications for Naval Tactical Networking (NTN).</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603271N: Electromagnetic Systems Advanced Technology		PROJECT 2913: Electromagnetic Systems Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
SATCOM Vulnerability Mitigation: - Initiate development of hardware and software appliques that implement waveforms, protocols, and techniques to significantly increase the data throughput on High Frequency (HF) communications channels. - Initiate development of multi-link, UHF, millimeter wave, air-to-air, air to ground and SATCOM terminals for networking airborne platforms with other airborne assets.						
Long Range Detection and Tracking: - Continue FNC EC Long Range Detection and Tracking. Capture and extend the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM). This effort demonstrates the ability to perform simultaneous full volume radar coverage of contacts at long ranges and in dense contact environments.						
Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue to develop and demonstrate affordable components in beamforming element chains for efficient S- and X-Band radar, and EA using highly efficient digital solid state electronics components covering the RF and microwave frequencies.						
Countermeasure Technologies for Anti-Ship Missile Defense (ASMD): - Continue the Enhanced Nulka Payload FNC effort by starting system architecture design. This effort develops an affordable and extremely compact RF payload for the Nulka offboard decoy with an Electronically Scanned Array (ESA) transmitter, compact receiver chain, and advanced isolation materials. - Continue the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by starting system architecture design and Low Voltage Gallium Arsenide (GaAs) High Power Amplifier (HPA) Monolithic Microwave Integrated Circuit (MMIC) purchases. This effort develops						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
affordable and reliable solid state transmitter technologies to engage anti-ship cruise and ballistic missile RF seekers.  Next Generation Countermeasure Technologies for Ship Missile Defense: - Continue the development of technologies to demonstrate effective EW countermeasures for ship missile defense operations in a distributed coordinated manner across the entire battlespace.  Next Generation Airborne Electronic Attack: - Continue the Next Generation Airborne Electronic Attack FNC effort by demonstrating critical subsystems operating in the RF low- and mid-bands. This effort develops and demonstrates advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide suppression of enemy air defenses (SEAD), deliver non-kinetic fires, counter integrated air defense systems (IADS), and provide suppression of C3 links and data networks.  FY 2011 Base Plans: Affordable Common Radar Architecture (ACRA): - Continue all efforts of FY 2010.  Low Cost Over The Horizon (OTH) Communication, SATCOM and Line Of Sight (LOS) Apertures: - Complete H-60 Tactical Common Data Link (TCDL) project (also known as Air Platform Relay and Routing). This effort develops a scalable, low cost, light weight, low drag multichannel TCDL relay and networking terminal. - Complete Low cost SATCOM-on-the-Move array for Marine Corps. This effort develops a low cost, scaleable SATCOM on-the-move communications terminal design for both HDR and LDR Marine Corps vehicular communications. - Complete nested, coplanar array/MILES design and integration. This effort develops a						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
communications array which will provide Ku-Band line of sight communications for naval tactical networking afloat.						
SATCOM Vulnerability Mitigation: - Continue all efforts of FY 2010.						
Long Range Detection and Tracking: - Complete FNC EC Long Range Detection and Tracking. Capture and extend the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture DAR single face ADM. This effort demonstrates the ability to perform simultaneous full volume radar coverage of contacts at long ranges and in dense contact environments.						
Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue all efforts of FY 2010.						
Countermeasure Technologies for Anti-Ship Missile Defense (ASMD): - Continue all efforts of FY 2010.						
Next Generation Countermeasure Technologies for Ship Missile Defense: - Continue all efforts of FY 2010.						
Next Generation Airborne Electronic Attack: - Continue all efforts of FY 2010.						
Global Applications for Data Exfiltration (GLADEX): - Initiate the development, integration, and demonstration of a nano-sat satellite bus with all its requisite structural, power, thermal, control, and separation subsystems.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate the development, integration, and demonstration of a nano-sat compatible payload and ground terminal for monitoring and relay of unattended sensor data.</p> <p>Radar Electronic Attack (EA) Protection:</p> <p>- Initiate the Identification and Defeat of Electronic Attack Systems (IDEAS) FNC effort by developing single platform precision passive electronic support measure (ESM) and electronic protection (EP) techniques and technology to counter hostile use of modern EA self protection jammers.</p> <p>Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3:</p> <p>- Initiate JCREW 3.3 component development.</p>						
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY		0.000	4.458	4.601	0.000	4.601
<p>The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using either GPS systems, non-GPS navigation devices, or atomic clocks. This activity will increase the operational effectiveness of U.S. Naval units. The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS).</p> <p>Efforts identified in this R2 activity transfer from PE 0603235N in FY 2010.</p> <p>The major objectives of this activity are:</p> <p>a) GPS Anti-Jam Antennas and Receivers - Integrate and demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; to integrate and demonstrate anti-spoofers/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>b) Precision Time and Time Transfer - Integrate and demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; to integrate and demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time.</p> <p>c) Non-GPS Navigation Technology - To integrate and demonstrate inertial navigation systems for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; to integrate and demonstrate a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals.</p> <p>The following are non-inclusive examples for projects funded in this activity.</p> <p><i>FY 2010 Plans:</i></p> <p>GPS Anti-Jam Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Continue the Adaptive Temporal Suppression of GPS Structured Interference project.</li><li>- Continue the GPS anti-spoofing antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system.</li></ul> <p>Precision Time and Time Transfer:</p> <ul style="list-style-type: none"><li>- Continue the development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO).</li></ul> <p>Non-GPS Navigation Technology:</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer.</li><li>- Continue the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.</li><li>- Continue the MEMS Gyro-cluster INS for Tactical Platforms project.</li><li>- Continue the Precision Celestial Navigation System (PCNS) project.</li><li>- Continue the Dead Reckoning Advanced Tight Coupling (DRATC) project.</li><li>- Continue the navigation grade Inertial Navigation System (INS) using fiber optic/MEMS gyros and electro-optic accelerometers.</li><li>- Continue the development of the Sonar Aided Bathymetric Navigation Technology.</li><li>- Continue the Optically Transduced MEMS Inertial Navigation System project.</li><li>- Continue the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project.</li><li>- Continue the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <p>GPS Anti-Jam Antennas and Receivers:</p> <ul style="list-style-type: none"><li>- Complete Adaptive Temporal Suppression of Structured Interference.</li><li>- Complete Anti-spoof Antenna Electronics using ESM and tracking.</li><li>- Initiate Small Antenna Based Anti-spoofing project.</li><li>- Initiate Advanced Spoofer Tracking.</li><li>- Initiate Next Generation Global Positioning Satellite System - Situational Awareness (XGPSS-SA) Challenged Environment.</li></ul> <p>Precision Time and Time Transfer:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Initiate Distributed Time-frequency Device.</li><li>- Initiate Tactical Grade Atomic Clock.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Non-GPS Navigation Technology: - Continue all efforts of FY 2010. - Complete 5-cc Accelerometer with EGI System. - Complete MEMS Gyro-cluster. - Complete PCNS project. - Complete DRATC project. - Complete navigation grade INS using MEMS gyro project. - Complete Sonar Bathymetric Navigation. - Initiate Wavewinds project. - Initiate Small Unmanned Underwater Vehicle - Sonar Aided Inertial Navigation Technology (UUV-SAINT) project. - Initiate Portable PCNS project.						
INTEGRATED TOPSIDE (INTOP) INNOVATIVE NAVAL PROTOTYPE (INP)  The overarching objective of the INTOP INP is to develop and demonstrate a prototype that integrates RF functions (EW, Radar, Communications, Navigation) into a common set of multi-function apertures through an architecture that is modular, scalable across all platforms, and open at the RF as well as computer and software level. The apertures are capable of providing multiple simultaneous, independent beams which can together perform any of the above functions.  Effective FY 2010, resources and budget justification associated with Integrated Topside (INTOP) formerly referred to as Integrated Digital Apertures and Array Radar System (IDAARS) effort are realigned from the activity titled ADVANCED MULTI-FUNCTION RF TECHNOLOGY. This realignment allows for improved description of the critical and unique application of technology, program technical initiatives, and associated resources within the INP program. IDAARS commenced in FY 2009.  The major objectives of this activity are:		0.000	21.098	38.418	0.000	38.418

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
a) Submarine SATCOM Array - Develop wide-band SATCOM array capable of supporting EW for submarines.						
b) Electronic Attack (EA) for Surface Combatants - Develop wide-band transmit array to support EA capability and other functions for surface combatants with potential application to other platforms.						
c) Architecture, Standards and Devices - Develop architecture and standards for wide-band multi-beam, multi-band arrays and below deck systems and the technology and electronic devices needed to make integrated array systems affordable.						
d) Surface Combatant Communication Array - Develop wide-band surface combatant communication array capable of supporting other RF functions.						
e) Resource Allocation Manager - Develop enterprise common Resource Allocation Manager.						
The increase from FY 2010 to FY2011 is due to increased investment required for the initiation of the development of prototype capability for EA for Surface Combatants.						
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.						
FY 2010 Plans: Submarine SATCOM Array: - Complete technical studies of enabling radio frequency (RF) components for submarine SATCOM arrays. - Continue SATCOM Array technical designs. - Initiate prototype array development.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>Electronic Attack (EA) for Surface Combatants:</p> <ul style="list-style-type: none"><li>- Complete studies for EA design as follow-on to Multi-Function Electronic Warfare (MFEW) capability for forward-fit and back-fit.</li><li>- Initiate design of EA capability.</li></ul> <p>Architecture, Standards and Devices:</p> <ul style="list-style-type: none"><li>- Continue IDAARS, a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and provide the appropriate control and synergy of the functionality such that the RF functions automatically support one another providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle to ensure continuing competition for maintenance and replacement parts.</li><li>- Continue development of architecture and interfaces and their application to wide-band SATCOM arrays for submarines.</li><li>- Initiate development of deckhouse and platform integration strategies and concepts.</li></ul> <p>Surface Combatants Communications Array:</p> <ul style="list-style-type: none"><li>- Initiate studies of array concepts.</li></ul> <p>Resource Allocation Manager:</p> <ul style="list-style-type: none"><li>- Continue development of functional queue management software.</li><li>- Continue development of control interface software for the resource allocation manager.</li></ul> <p><i>FY 2011 Base Plans:</i> Submarine SATCOM Array:</p>						

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603271N: Electromagnetic Systems Advanced Technology				PROJECT 2913: Electromagnetic Systems Advanced Technology			
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0602271N: ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	14.673	19.469	28.829	0.000	28.829	24.803	11.936	5.151	1.303	0.000	106.164
D. Acquisition Strategy N/A											
E. Performance Metrics Advanced Electronic Sensor Systems for Missile Defense and Long Range Detection and Tracking ECs are aligned to the Navy's Advanced Cruiser (CG(X)) plans and closely coordinated with Naval Sea Systems Command Integrated Warfare Systems (PEO IWS 2.0). Other performance metrics are discussed within the R-2a.											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603271N: <i>Electromagnetic Systems</i> <i>Advanced Technology</i>				<b>PROJECT</b> 2933: <i>Wide Focal Planar Array Camera S&amp;T</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2933: <i>Wide Focal Planar Array Camera S&amp;T</i>	0.000	0.000	0.000	14.100	14.100	0.000	0.000	0.000	0.000	0.000	14.100
<p><b>Note</b> This is a new Overseas Contingency Operations (OCO) project.</p> <p><b>A. Mission Description and Budget Item Justification</b> This effort develops technology to support the maturation and demonstration of sensing and analysis capabilities that can enhance wide area tactical situational awareness and generate actionable intelligence.</p> <p><b>B. Accomplishments/Planned Program (\$ in Millions)</b></p>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
Wide Focal Planar Array Camera S&T						0.000	0.000	0.000	14.100	14.100	
<p>This effort develops technology to support the maturation and demonstration of sensing and analysis capabilities that can enhance wide area tactical situational awareness and generate actionable intelligence.</p> <p>The major objectives of this activity are:</p> <p>A) Wide Focal Plane Array Camera (WFPAC) sensor - Develop an airborne sensor payload for a Group two-third form factor and procurement of a limited quantity of payloads in support of Unmanned Aerial Vehicle (UAV) integration and field user evaluation. Effort will also develop an advanced Mid Wavelength Infrared (MWIR) focal plane array in order to enable a night Group two-third wide area airborne payload and support Navy UAV integration effort as required.</p>											

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>								
				<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>FY 2011 Base Plans:</b> N/A  <b>FY 2011 OCO Plans:</b> <ul style="list-style-type: none"> <li>- Initiate and Complete effort to complete development, testing, integration and initial procurement of a Wide Focal Plane Array Camera (WFPAC) sensor for the RQ-7 "Shadow" Unmanned Aerial System (UAS), also referred to as the Marine Corps Tactical Unmanned Aerial System (MCTUAS), in support of OEF-Afghanistan.</li> <li>- Initiate and Complete development of a 59 megapixel WAAS payload in a shadow form factor by maturing the data link, adding color and a dual field of view for the purposes of field user technology and CONOPs evaluation, fabricate a limited number of sensors (4).</li> <li>- Initiate and Complete maturation for the design of a 64 megapixel mid range IR focal plan array.</li> </ul>								
Accomplishments/Planned Programs Subtotals				0.000	0.000	0.000	14.100	14.100
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A								
<b>D. Acquisition Strategy</b> N/A								
<b>E. Performance Metrics</b> Successful development of a sensor to provide a 16 square kilometers persistent field of view with a .5m resolution at 10 frames per second (fps), which would allow real time for up to 10 local Common Data Link transceivers while also being stored for post-mission exploitation and forensics at two fps.								

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
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<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	18.948	16.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	131.879
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: C BAND ACTIVE ARRAY RADAR  <i>FY 2009 Accomplishments:</i> This effort supported the development of a C-Band Active Array Radar technology demonstrator.							3.989	0.000			
Congressional Add: PACIFIC AIRBORNE SURVEILLANCE & TESTING  <i>FY 2009 Accomplishments:</i> This effort supported the development of long range surveillance and reconnaissance capabilities that include feature aided tracking, operability in jamming environment, restricted spectrum, and identification of contacts.  <i>FY 2010 Plans:</i> Continues support of Pacific Airborne Surveillance and Testing research.							14.959	16.929			
Congressional Adds Subtotals							18.948	16.929			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
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<p><b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A</p> <p><b><u>D. Acquisition Strategy</u></b> N/A</p> <p><b><u>E. Performance Metrics</u></b> Congressional Interest Items not included in other Projects.</p>		

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603640M: MC Advanced Technology Demo							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	102.534	129.962	115.089	0.000	115.089	125.126	130.122	133.063	135.810	Continuing	Continuing
2223: Marine Corps ATD	58.003	70.421	78.087	0.000	78.087	84.475	86.827	88.785	90.616	Continuing	Continuing
2297: Marine Corps Warfighting Lab - Core	35.475	36.419	37.002	0.000	37.002	40.651	43.295	44.278	45.194	Continuing	Continuing
9999: Congressional Adds	9.056	23.122	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	94.554

**A. Mission Description and Budget Item Justification**

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential S&T efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

As a key component of naval expeditionary forces, the Marine Corps has unique and technologically stressing requirements because of its expeditionary mission and intensive operational tempo, Marine Air-Ground Task Force (MAGTF) structure, and conduct of maneuver warfare. Critical requirements in this program element (PE) are: Command, Control, Communications, Computers (C4), Intelligence, Surveillance, and Reconnaissance (ISR); maneuver techniques and means; force protection; logistic sustainment; human performance, training and education; and firepower. There are ongoing actions to develop and demonstrate advanced technologies and concepts in operational environments. Joint service efforts are aligned with Defense Technology Objectives and Joint Warfighting Capability Objectives. In addition, there is funding for experimentation in warfighting concepts as well as operational assessment of emerging technologies, to include technical support of operating forces to assess military utility of selected technologies. This PE specifically supports: continued development of Distributed Operations (DO) through field experiments with Marine infantry battalions; rapid response to low-, mid-, and high-intensity conflicts in the Overseas Contingency Operation (OCO); methods for countering irregular threats; and expansion of seabasing and naval force packaging capabilities. The investment directly assists in fulfilling the forward presence requirements of Sea Shield and the transformational capabilities prescribed by Sea Strike. The Future Naval Capability (FNC) process is supported and funds are programmed accordingly. This PE is largely focused on demonstration of products and capabilities from the knowledge base and Discovery and Invention (D&I) phases of Naval Science and Technology (S&T). As Naval partners, the Navy and Marine Corps S&T Team strive to transition technologies that will implement objectives outlined in the Naval Operations Concept. This PE also funds technical solutions designed to increase Naval force capability, such as the Naval Expeditionary Combat Command.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0603640M: MC Advanced Technology Demo			
BA 3: Advanced Technology Development (ATD)					
Investments in S&T provide the opportunities for future capabilities and will prevent technological surprise. The PE as a whole will advance the amphibious and expeditionary capabilities for the Combatant Commanders helping to meet their emerging challenges by enhancing Naval S&T contributions to the long commitment to the OCO.					
Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	103.296	107.363	0.000	0.000	0.000
Current President's Budget	102.534	129.962	115.089	0.000	115.089
Total Adjustments	-0.762	22.599	115.089	0.000	115.089
• Congressional General Reductions		-0.503			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.078			
• Congressional Adds		13.700			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.130	0.000			
• SBIR/STTR Transfer	-2.089	0.000			
• Program Adjustments	0.000	0.000	115.089	0.000	115.089
• Rate/Misc Adjustments	0.000	9.480	0.000	0.000	0.000
• Congressional Recision Adjustments	-0.003	0.000	0.000	0.000	0.000
• Congressional Add Adjustments	1.200	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: California Central Coast Partnership Research					
Congressional Add: Enhanced Small Arms Protective Insert					
Congressional Add: Future Immersive Training					
Congressional Add: CRAFT INTEGRATED ELECTRONIC SUITE (CIES)					
Congressional Add: MARINE AIR-GROUND TASK FORCE SITUATIONAL AWARENESS					

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>		<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603640M: <i>MC Advanced Technology Demo</i>	
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>		<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: <i>Ballistic Helmet Development</i>		1.197	0.000
Congressional Add: <i>Ground Warfare Acoustical Combat System of Netted</i>		1.995	4.979
Congressional Add: <i>Near Infrared optical (NIRO) Augmentation System</i>		0.798	1.593
Congressional Add: <i>Hybrid Capacitor Supercell for Marine Combat Vehic</i>		1.197	0.000
Congressional Add Subtotals for Project: 9999		9.056	23.122
Congressional Add Totals for all Projects		9.056	23.122
<b><u>Change Summary Explanation</u></b>			
<p>Technical: FY 2009 reflects funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. DoD directed this initiative in response to the determination that its S&amp;T investment is likely too small to meet the imposing security threats that challenge our Nation, and it may not be adequately postured to take advantage of key scientific and technological opportunities that offer breakthrough advantages to our warfighters. This broad, multi-year (through the FYDP) initiative will expand existing technology integration and increase/spur the application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes; therefore, funding associated with this DoD initiative is reflected throughout the PE. In FY 2010 preparation efforts continue in areas of technology that are ready for major, integrated technology demonstration. All technical work is being coordinated throughout DoD on these demonstrations. In areas such as vehicle technology demonstrations, the goal is to deliver multiple classes of advanced technology ground vehicle demonstrations leading to new classes of protective, efficient, ground vehicles.</p> <p>Schedule: Project 2297, Worldwide contingency and combat operations (i.e. Operation Iraqi Freedom (OIF) campaigns, humanitarian efforts, and others) have increased the operations tempo of United States Operating Forces to the extent that their support of and participation in the Marine Corps Warfighting Laboratory (MCWL) experimentation was/remains substantially reduced. Events are rescheduled and adjusted so that operational assessments may be conducted by operational units preparing to deploy to Iraq/Afghanistan and subsequently in Iraq/Afghanistan in order to accommodate troop availability.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603640M: <i>MC Advanced Technology Demo</i>				<b>PROJECT</b> 2223: <i>Marine Corps ATD</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2223: <i>Marine Corps ATD</i>	58.003	70.421	78.087	0.000	78.087	84.475	86.827	88.785	90.616	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Force Protection; Human Performance, Training and Education; Logistics; Command, Control, Communications and Computers (C4); Intelligence, Surveillance and Reconnaissance (ISR) and Firepower. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development Phase are planned, as well as fieldable prototyped to reduce risk in System Concept Development and Demonstration. A tactically effective Mine Countermeasures (MCM) capability is vital to Force Protection and necessary if Maneuver on land is to become a functional component of Naval Expeditionary Maneuver Warfare. Maneuver, supported by MCM provides synchronization and speed of detection, breaching, clearance, proofing, and marking operations. This project supports: 1) engaging regional forces in decisive combat on a global basis; 2) responding to all other contingencies and missions in the full spectrum of combat operations (high, middle, and low intensity), in Military Operations in Urban Terrain (MOUT), and in Operations other than War (OOTW); and 3) warfighting experimentation. By providing the technologies to enable these capabilities, this project supports the goals and objectives of the Strike, Littoral Warfare and Surveillance Joint Mission Areas. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment.

In addition, this project supports the goals and objectives of the Littoral Combat/Power Projection related Enabling Capability (EC) within the Future Naval Capabilities (FNC) portfolio. The focus of the EC within this PE is technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Marine Corps operations in Iraq and Afghanistan and is one of the highest ranked Capability Gaps prioritized by the Chief of Naval Operations and the Marine Corps Combat Development Command (MCCDC). The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4)  This activity integrates and demonstrates enhanced communications and situational awareness in warfighting environments and communication and situational awareness technologies for near term USMC operations. The focus is on development and leveraging advanced C4 technologies to	3.613	5.987	5.432	0.000	5.432

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603640M: MC Advanced Technology Demo		PROJECT 2223: Marine Corps ATD		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
enable enhanced Distributed Operations, Irregular Warfare, and Marine Corps Expeditionary Warfare. Specifically, the C4 Thrust intends to demonstrate markedly improved capabilities in over-the-horizon (OTH), beyond line-of-sight, and restricted environment communications; mobile networking; tactical decision making; tactical situational awareness; and small unit position location and navigation. Advanced technology resources will be applied to complement commercial, other service, and defense agency investments to produce a technology base to address identified Marine Corps technology gaps.						
FY 2009 to FY 2010 reflects a funding increase for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs; - Personal protection materials; - Personal power generation; - Micro power sources; and - Augmented reality. The C4 activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.						
The FY 2009 to FY 2010 increase in funding is due to acceleration of the schedule of the Software Reprogrammable Payload and Satellite Communications On-The-Move Integration efforts in order to meet transition milestones. The FY 2010 resources complete the SRP program S&T and enables transition the capability to 6.4. SRP is a high priority Navy/MC Aviation program that will enable on-the-fly reconfigurable, multiple, simultaneous missions and applications in a single payload. Navy will deliver an integrated hardware prototype, software, firmware, and supporting documentation to the transition sponsor (Navy/MC Aviation).						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued urban navigation with limited Global Positioning System availability demonstrations. (Realigned from C4ISR Activity) - Continued demonstrations of improved urban communications capabilities. (Realigned from C4ISR Activity) - Continued creating a service oriented sensor network for expeditionary forces' current and future tactical sensors. (Realigned from C4ISR Activity) - Continued developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace. (Realigned from C4ISR Activity) - Continued creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone. (Realigned from C4ISR Activity) - Completed conformal antenna integration and demonstrations. (Realigned from C4ISR Activity) - Initiated an Assured Connectivity effort to develop waveforms suited to maintaining low data rate links under extreme conditions.					
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as completed above. - Complete Common Operational Picture Fusion Tools efforts, Software Reprogrammable Payload, Satellite Communications On-The-Move integration and demonstration, and C3 for the Individual Marine Spiral One.					
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Complete Fires interoperability, Advanced HF Communications and Restricted Communications. - Initiate Application-Network Architectures, Conformal Antenna Integration and Demonstration Spiral 2 and C3 for the Individual Marine Spiral Two.					
FIREPOWER	5.957	5.935	7.044	0.000	7.044

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: fuze, fire control, launch/propulsion, lethality, and accuracy.</p> <p>The resources reflect an increase for emerging priority requirements in lightening the load of the individual Marine while simultaneously enhancing the combat capabilities of the Marine Corps Rifle Squad and for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs;</li><li>- Personal protection materials;</li><li>- Personal power generation;</li><li>- Micro power sources; and</li><li>- Augmented reality.</li></ul> <p>The Firepower activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.</p> <p>The FY 2010 to FY 2011 funding increase is due to the acceleration and completion of a Non-Magnetic Azimuth Sensing technology effort. This will allow early transition of warfighting capability to Marine Corps forces.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued scalable effects conventional warhead concept development.</li><li>- Continued MACHSI advanced technology development.</li><li>- Continued improved mortar munition integration and demonstrations.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity supports the Force Protection Thrust's Advanced Technology Demonstration efforts in the areas of individual Marine platforms, equipment and autonomous systems. This includes technologies to enable detection, neutralization, breaching, and clearing of mines, Improvised Explosive Devices (IEDs), and unexploded ordnance from the beach exit to inland objectives. Efforts supported under Force Protection also include the demonstration of technologies such as Counter Rocket, Artillery, and Mortar (CRAM) and Counter Sniper technologies in support of maneuver warfare, small unit distributed operations, and fixed installation protection and technologies for improved Personnel Protective Equipment for individual protection against blast, ballistic, and blunt impact threats as well as in a chemical, radiological, and biological environment. Physical Security technologies to support expeditionary maneuver warfare, pier/port and base infrastructure are also addressed under this thrust. Beginning in FY 2009, Mine Countermeasures (MCM) efforts will be funded within the Force Protection activity. FY 2009 is the first reporting cycle where Force Protection Thrust efforts are separated from the Maneuver activity. Counter-IED and Counter-RPG Technologies remain high priority Marine Corps focal areas.</p> <p>FY 2009 reflects additional funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs;</li><li>- Personal protection materials;</li><li>- Personal power generation;</li><li>- Micro power sources; and</li><li>- Augmented reality.</li></ul> <p>The Force Protection activity is central to the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.</p>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The FY2009 to FY 2010 increase in funding results from acceleration of effort needed to complete advanced countermeasures technology development against magnetic fuzed landmines and to complete development of point detection of explosives associated with Improvised Explosive Devices (IEDs).						
The FY 2010 to FY 2011 increase in funding is due to operational requests to explore S&T solutions to neutralize incoming rocket, artillery, and mortar threats via non-kinetic means.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication.</li><li>- Continued development of technologies to locate and defeat IEDs.</li><li>- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared).</li><li>- Continued efforts to detect IEDs using radio frequency sources.</li><li>- Continued technology development programs to address force protection capability gaps.</li><li>- Completed studies to identify technology development plans and develop roadmaps to close identified force protection capability gaps.</li><li>- Completed design of a novel low passive inter-modulation wideband antenna for use against multiple classes of radio frequency triggered IEDs.</li><li>- Completed investigation of polarization diversity designs to counter specific placements and orientations of radio frequency triggered IEDs.</li><li>- Initiated new Explosives Hazard Defeat to address the Suicide-Bomber threat. This effort will combine multiple sensor modalities, analysis algorithms, and data fusion to demonstrate high Pd, low FAR detection of suicide bombers from standoff distances from multiple aspect angles.</li><li>- Initiated a new Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div>- Initiated Warfighter modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters.</div> <div>FY 2010 Plans:</div> <div><div>- Continue all efforts of FY 2009 less those noted as completed above.</div><div>- Complete advanced countermeasures technology development against magnetic fuzed landmines.</div><div>- Complete development of point detection of explosives associated with IEDs. (Relates to the FY 2009 plan to detect IEDs using radio frequency sources).</div><div>- Initiate high-power solid state source development for IED neutralization.</div><div>- Initiate vulnerability assessment of threat targeting sensors to directed energy.</div></div> <div>FY 2011 Base Plans:</div> <div><div>- Continue all efforts of FY 2010, less those noted as completed above.</div><div>- Complete modeling and simulation (M&amp;S) efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters.</div><div>- Complete countermeasures technology development against seismic fuzed landmines.</div><div>- Complete development of stand-off detection of explosives utilizing Raman and Laser Induced Breakdown Spectroscopy sensor modalities. (Relates to FY 2009 initiation of new Explosives Hazard Defeat Plan).</div><div>- Initiate efforts to neutralize incoming rocket, artillery, and mortar threats via non-kinetic means.</div><div>- Initiate development and evaluation of landmine detection utilizing ground penetrating radar from an airborne platform.</div></div>					
HUMAN PERFORMANCE, TRAINING & EDUCATION  This activity develops and demonstrates advanced training technology and technologies that enhance neural and cognitive aspects of human performance including tactical decision-making, modeling, simulation, range instrumentation, synthetic environment generation and training effectiveness evaluation.	7.249	9.172	10.693	0.000	10.693

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The resources reflect an increase for enhanced requirements in support of Distributed Operations and for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs;</li><li>- Personal protection materials;</li><li>- Personal power generation;</li><li>- Micro power sources; and</li><li>- Augmented reality.</li></ul> <p>The Human Performance, Training and Education activity is key to the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.</p> <p>The FY 2009 to FY 2010 funding increase is due to enhanced development of early prototype systems for Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality and mixed reality squad level training in support of the Marine Corps concept for Distributed Operations).</p> <p>The FY 2010 to FY 2011 funding increase is due to planned initiation of efforts to apply learning theories for language and culture training and to initiation of related efforts in team immersive language and cultural learning in simulation environments.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued the development of tools to capture metrics and lessons learned from a variety of simulation and training sources.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued Marine Advanced Combat Headborne Initiative (MACHSI): physical protection of the head, neck and face. (Transitioned from the Firepower activity.)</li><li>- Continued development of the Distributed Operations Training/Virtual Test Bed.</li><li>- Continued research into environmental effects on cognitive and team performance.</li><li>- Initiated development of adaptive experiential learning tools for Distributed Operations Training.</li><li>- Initiated in-depth analysis, state-of-the-art report, and testing on all USMC physical training regimens, their effectiveness and their injury incidence rates.</li><li>- Initiated development of "Warfighter as a System" modeling tools.</li><li>- Initiated development of automated behavioral and neurophysiological performance measurement technologies for Distributed Operations Warfighter assessment, classification and assignment to training.</li><li>- Initiated Human Performance and Training capabilities (Cognitive and physical enhancement, modeling and simulation, virtual reality squad level training) in support of Distributed Operations.</li><li>- Initiated demonstrations and field studies of mitigation/augmentation capabilities that enhance squad level communication in support of Distributed Operations.</li><li>- Initiated development of a Distributed Operations virtual reality simulation training system prototype that will be scalable across fire team, squad, and platoon.</li><li>- Initiated Lightening the Load efforts aimed at developing the software necessary to conduct trade off analysis on a physically and ergonomically accurate model of the United States Marine and its infantry equipment.</li><li>- Initiated new Experiential Learning Technologies to improve the Infantry Immersive Trainer to support the Squad Immersive Training Environment (SITE) Marine Corps Urgent Needs Statement. This includes developing tracking, Helmet Mounted Displays, and software technologies to enable Augmented Reality in unimproved locations.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate evaluations and validations of applications geared towards peak neural and cognitive performance-in distributed operations.</li><li>- Initiate Distributed Operations training system investigations into perceptual skills enhancement that lead to enhanced cognition and decision making.</li><li>- Initiate development of early prototype systems for Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality and mixed reality squad level training in support of Distributed Operations).</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete development of adaptive experiential learning tools for Distributed Operations Training.</li><li>- Complete in-depth analysis, state-of-the-art report, and testing on all USMC physical training regimens, their effectiveness, and their injury incidence rates.</li><li>- Complete development of "Warfighter as a System" modeling tools.</li><li>- Initiate efforts to apply learning theories for language and culture training.</li><li>- Initiate team immersive language and cultural learning in simulation environments.</li><li>- Initiate classroom/field testing of learning theories extended to complex tasks for a range of expertise levels; training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise; and principles of expertise development on a continuum of novice to expert.</li><li>- Initiate field evaluations of training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.</li><li>- Initiate effectiveness and validation studies of Advanced Mobile Assessment and Field Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile and rugged tools, algorithms, and models.</li></ul>						
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)		2.271	3.124	3.644	0.000	3.644
This activity supports the demonstration of technologies to enhance situational awareness and tactical decision making through automated analysis, fusion of data, rapid integration of information,						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603640M: MC Advanced Technology Demo		PROJECT 2223: Marine Corps ATD		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>and acquired knowledge resulting in actionable intelligence at the lower command levels. The activity includes the demonstration of ISR efforts involving enhanced reconnaissance and persistent surveillance, and sensors for unmanned ground and aerial vehicles. Advanced Technology demonstrations also include the collection of information [monitoring, sensing, and locating] in the 3D urban battlespace as well as exploiting information [identifying and classifying data] as part of the intelligence preparation of the battlespace in order to facilitate operational maneuver and distributed operations.</p> <p>The funding reflect an increase for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs;</li><li>- Personal protection materials;</li><li>- Personal power generation;</li><li>- Micro power sources; and</li><li>- Augmented reality.</li></ul> <p>The ISR activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.</p> <p>The FY 2009 to FY 2010 funding increase is due to planned acceleration of work to refine enemy course of action prediction software to adapt to stimuli.</p> <p>The FY2010 to FY2011 funding increase is due to initiation of robust efforts to automatically fuse data across all identifiers (TTL, biometrics, symbols) based on similarity measures.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued development of advanced tactical sensor nets that localize mobile detection of threats in a complex environment. (Realigned from C4ISR Activity) - Continued development and demonstration of measurement and signature intelligence data management and integration capability. (Realigned from C4ISR Activity) - Continued integration and demonstration of naval tactical warfighting applications and network connectivity. - Continued tagging, tracking, and locating efforts to demonstrate the effectiveness of tactically relevant tag readers which support track classification algorithms. (Realigned from C4ISR Activity) - Continued efforts to refine enemy course of action prediction software to adapt to stimuli. (Realigned from C4ISR Activity) - Continued and initiate new Actionable Intelligence for Expeditionary and Irregular Warfare efforts which include Human Network Decision Modeling and the fusion across modeling approaches to increase prediction accuracy. (Realigned from C4ISR Activity) - Initiated development of tactical sensor nets with organic unattended multi-level security processing and information dissemination. - Initiated new Relevant and Situational Information on Demand such as Identity Dominance Enabled by an Integrated Biometric/Tag Track and Locate (TTL) Capability, providing human tracking algorithms based on models of biometric (face, voice and soft) and TTL (optical taggant) capabilities and modeling a biometric/optical taggant system relevant to human tracking across an urban 5 km x 2 km area. - Initiated new Sensor Fields efforts such as Nanotechnology Enabled Witness Fields, development of sensors that provide near real time decision support to distributed operations by detecting specific interactions, and nanotechnology efforts which offer the potential to revolutionize tactical sensors. To enable this capability, nanomaterials that change state in the presence of another nanomaterial will be developed.						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Complete efforts to refine enemy course of action prediction software to adapt to stimuli.</li><li>- Initiate tagging, tracking, and locating efforts to demonstrate a system that will automatically translate large amounts of wide area surveillance data into tracks, useful to expose entity to entity associations; build urban context, as well as detect events and anomalies; and associate objects, tasks, locations and events for creating actionable intelligence.</li><li>- Initiate algorithm development for base classification on context, similarity to clutter, and nearness to suspicion.</li><li>- Initiate efforts to analyze and expose enemy networks using close observations of entity to entity associations and social network analysis.</li><li>- Initiate efforts to develop methods and techniques for investigating open source information on the Internet to form a human terrain map indicating space and time features to aid network identification and prediction of enemy activity.</li><li>- Initiate efforts to incorporate social models for human decision making with statistical models.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Initiate new Operational Adaptation Enablers effort to provide one analysis framework for the incorporation of interdisciplinary techniques related to addressing contextual questions.</li><li>- Initiate efforts to extend the utility of track classification algorithms to sparse data.</li><li>- Initiate efforts to automatically fuse data across all identifiers (TTL, biometrics, symbols) based on similarity measures.</li><li>- Initiate efforts to show entity tracking using disparate ground and air sensors.</li></ul>						
LITTORAL COMBAT/POWER PROJECTION (LC/PP)		16.675	17.111	17.622	0.000	17.622

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This activity is aligned with the Sea Strike, Sea Shield, Sea Basing, FORCEnet and the Expeditionary Maneuver Warfare pillars as well as Force Health Protection and Platform Enablers. It provides the capability for the demonstration and transition of technologies developed through the related Marine Corps S&amp;T programs directly to an acquisition program of record. Littoral Combat/Power Projection is the Enabling Capability (EC).</p>						
<p>The funding profile reflects the alignment of the FNC program investments into ECs. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. The focus of the ECs within this PE will be on technology related to Urban, Asymmetric, Littoral and Expeditionary Operations. The related science and technology development is of the highest importance to Marine Corps operations in Iraq, Afghanistan and the OCO. Understandably, these Warfighter Capability Gaps are among those highest ranked of the prioritized Capability Gaps (prioritized by the OPNAV and the MCCDC). The technologies associated with these gaps are being pursued as part of an overall effort that addresses Sea Strike, Sea Shield, Sea Basing and FORCEnet Capability Gaps. Warfighter Capability Gaps are made up of ECs and supporting products. This activity includes support to the Urban, Asymmetric Operations-related to EC's for IED's, Modular Scalable Effects Weapons, Advanced Naval Fires Technology, Dynamic Target Engagement, Position Location Information, Transparent Urban Structures, Hostile Fire Detection and Response, Lightweight Protective Systems, and Lightening the Load of Dismounted Combatants.</p>						
<p>FY 2009 Accomplishments:</p> <ul style="list-style-type: none"><li>- Continued development of improved lightweight computational fire control interface technology. (Concurrent funding from PE 0602131M, PE 0602236N, PE 0603236N and PE 0603782N)</li><li>- Continued development of improved fire control systems technologies to Expeditionary Fire Support System artillery and mortar systems (concurrent funding from PE 0602131M and 0602114N. These PEs complete the effort in FY 2010).</li><li>- Continued development of transparent urban structures technologies. (Concurrent funding from PE 0602131M)</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued development of modular scalable effects prototype weapon. (Concurrent funding from PE 0602131M)</li><li>- Continued development of counter improvised explosive devices technologies. (Concurrent funding from PE 0602131M)</li><li>- Continued development of tactical urban breaching technologies.</li><li>- Completed development of tools and technologies to support Marine Corps Intelligence, Surveillance and Reconnaissance (ISR) efforts Measurement and Signature Intelligence Tactical Remote Sensor System (MASINT/TRSS) in remote sensor integration within the Distributed Common Ground/Surface System (DCGS).</li><li>- Completed design and development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability. (Concurrent funding in PE 0602131M and 0602236N)</li><li>- Completed effort to incorporate advanced target acquisition target hand-off technologies to reduce sensor to shooter loop and improve target location. (Concurrent effort funded in PE 0602131M).</li><li>- Completed development of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield. (Concurrent funding provided by PE 0602131M).</li><li>- Completed integration of hostile fire detection and counter-fire system (GUNSLINGER). (Concurrent funding in PE 0602131M).</li><li>- Completed development of innovative relay Beyond Line of Sight (BLOS) technology through integration and demonstration of secure wireless networks/secure wireless local area network (LAN) communication technologies. (Concurrent funding in PE 0602131M, PE 0602236N, PE 0603236N and PE 0603782N).</li><li>- Initiated development of individual Warfighter protection technologies. (Concurrent funding in PE 0602131M; funding will also be provided by PE 0603236N in FY 2009).</li><li>- Initiated development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. (Concurrent funding in PE 0602131M; funding will also be provided by PE 0603236N in FY 2010).</li></ul>						

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APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603640M: MC Advanced Technology Demo		PROJECT 2223: Marine Corps ATD		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Continue all efforts of FY 2009. - Complete development and transition of improved fire control technologies based on small-scale hardened non-magnetic azimuth sensor to improve timeliness and accuracy of mortars/howitzers.						
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as complete above. - Complete development and transition transparent urban structures technologies which will enable tactical units to detect, classify and discriminate between friendly and enemy personnel in urban structures, and to gather ground data to dynamically develop 3D models to map urban areas using a UAV (Unmanned Air Vehicle)/UGV (Unmanned Ground Vehicle)-based system. (Concurrent funding provided by PE 0602131M.) - Complete development of individual warfighter lightweight protective system technologies that will reduce body armor weight, improve survivability and increase the mobility of the warfighter. - Initiate development of technologies to lighten the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing Graphical User Interface (GUI-based) software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0602131M and PE 0603236N.)						
LOGISTICS  This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.		7.612	11.468	13.125	0.000	13.125

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The resources reflect an increase for sustainability/logistics programs (includes fuel, water, ammunition, rations, and casualty care /MEDEVAC) in support of Distributed Operations; new USMC priorities in lightening the load of the individual Marine and enhancing the Marine Corps rifle squad's overall capabilities; and for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:</p> <ul style="list-style-type: none"><li>- Pre-detonation of IEDs;</li><li>- Personal protection materials;</li><li>- Personal power generation;</li><li>- Micro power sources; and</li><li>- Augmented reality.</li></ul> <p>The Logistics activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.</p> <p>The FY 2009 to FY 2010 funding increase results from plans to accelerate and complete development of both the portable fuel analyzer and the lightweight thermoelectric generator efforts.</p> <p>The FY 2010 to FY 2011 funding increase results from enhanced emphasis on the development of advanced lightweight fuel to energy conversion concepts.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued exploring the development of portable fuel cell technologies capable of providing power in the 100 Watt to 500 Watt power range.</li><li>- Continued efforts to develop a micro turbine generator capable of 100W average power.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued research into developing a replaceable electrode battery power source that consists of a metallic structure that is consumed during power generation and then easily replaced with a new metallic component that restores a full charge. (Realigned from PE 0602131M.)</li><li>- Continued analysis of material alternatives for automated vehicle health monitoring and reporting.</li><li>- Continued development of a tracking capability for major classes of supplies, forces &amp; equipment.</li><li>- Initiated technology demonstration for responsive precision aerial logistic transport from Seabase to Distributed Operations Squad or Platoon.</li><li>- Initiated technology demonstration of an innovative bridge structure constructed from highly versatile modular composite components, thus expanding site-specific assembly options while simplifying logistic transport.</li><li>- Initiated development of a backpack that prevents oscillatory and transient peak loading forces from causing skeletal injury while enhancing human mobility with heavy loads.</li><li>- Initiated development of a man-portable capability to analyze captured fuel for adulterants and contaminants.</li><li>- Initiated development of a lightweight man-portable multi-fuel thermoelectric battery charger.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete development of portable fuel analyzer.</li><li>- Complete development of lightweight thermoelectric generator.</li><li>- Initiate the development and demonstration of advanced materials for corrosion prevention and wear reduction for USMC vehicles and equipment.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete development of backpack designed to minimize injurious peak oscillatory skeletal loading.</li><li>- Complete technology demonstration of a full scale bridge constructed from lightweight versatile modular composite components.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate development of advanced lightweight fuel to energy conversion concepts.					
MANEUVER  The Maneuver Thrust Technology Area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of current and future Marine Corps maneuver systems. This Thrust aims at capturing emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Beginning in FY 2009, Mine Countermeasures (MCM) efforts are funded under the Force Protection activity. Presently, MCM supports and enhances the maneuver and force protection Marine landing forces with the development of technologies to enable detection, neutralization, breaching, and clearing of mines, Improvised Explosive Devices (IEDs), and unexploded ordnance from the beach exit to inland objectives. MAGTF MCM is a functional component of Naval Expeditionary Maneuver Warfare and includes Ship to Objective Maneuver (STOM), Expeditionary Operations from a Sea Base, sustained Operations Ashore, Urban and Asymmetric Operations, and OOTW.  The resources reflect an increase for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs; - Personal protection materials; - Personal power generation; - Micro power sources; and - Augmented reality. The Maneuver activity directly supports this integrated demonstration which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.	8.645	10.576	12.312	0.000	12.312

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The FY 2009 to FY 2010 increase in funding is due to expanded Survivability/Active Protection Systems Improvement efforts to increase effectiveness of defeat (Pdefeat) of shoulder launched Rocket-Propelled Grenade (RPG) type threats and Anti-Tank Guided Missile (ATGM) threats on light platforms utilizing non-kinetic kill technologies.						
The FY 2010 to FY 2011 increase in funding is to due to plans for a major demonstration of Integrated Armor Solutions that provide lighter weight armor materials with enhanced protection to vehicle occupants.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued Advanced Electromagnetic Armor technology development efforts.</li><li>- Continued development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication.</li><li>- Continued S&amp;T programs to address MAGTF Land MCM Master Plan capability gaps.</li><li>- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared).</li><li>- Continued the formation of blast consortia to foster the increased understanding of blast and fragmentation interaction with vehicles and biological effects.</li><li>- Continued development of a Combat S&amp;T vehicle prototype to enhance crew survivability and vehicle fuel efficiency.</li><li>- Continued efforts to detect IEDs using radio frequency sources.</li><li>- Continued studies to identify technology development plans to close identified force protection capability gaps.</li><li>- Continued development of a test bed to demonstrate advanced survivability concepts.</li><li>- Continued technology development programs to address force protection capability gaps.</li><li>- Continued development of fuel efficiency and battlefield power systems for improved performance.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiated development of a Combat S&amp;T Vehicle demonstrator to enhance crew survivability and vehicle fuel efficiency.</li><li>- Initiated survivability improvements and technologies to mitigate acceleration and traumatic brain injuries to occupants to enhance tactical mobility and survivability in support of Distributed Operations.</li><li>- Initiated advanced suspension systems development with ride height adjustment, ride quality adjustment, rollover prevention, and load equalizing systems for USMC tactical wheeled platforms to enhance tactical mobility in support of Distributed Operations.</li><li>- Initiated a Survivability/ Active Protection Systems Improvement effort to increase effectiveness of defeat (Pdefeat) of shoulder launched RPG type threats and ATGM threats on light platforms utilizing non-kinetic kill technologies.</li><li>- Initiated new mobility efforts for On-Board Vehicle Power to increase mobile exportable power for Diesel Electric Propulsion Concepts and a Fuels effort to investigate future fuel alternatives for internal combustion engines to include Fischer-Tropsch and coal gasification processes for use in military tactical wheeled vehicles.</li><li>- Initiated Maneuver Enabling Technologies such as Vehicle Stabilization to improve vehicle suspension and control technologies to stabilize the platforms themselves to improve ride quality, shoot on the move capability and human systems integration.</li><li>- Initiated a Vehicle Demonstrator program to design and fabricate an Integrated Power Demonstrator platform capable of producing the power needs for mobility and survivability concept demonstrations.</li></ul> <p>Acquisition Workforce Fund</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy						<b>DATE:</b> February 2010					
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603640M: <i>MC Advanced Technology Demo</i>			<b>PROJECT</b> 2223: <i>Marine Corps ATD</i>				
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
- Initiate efforts to demonstrate Integrated Armor Solutions that provide lighter weight armor materials with enhanced protection to vehicle occupants thereby enhancing tactical Mobility and Survivability in support of Distributed Operations.											
Accomplishments/Planned Programs Subtotals						58.003	70.421	78.087	0.000	78.087	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0603236N: <i>WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY</i>	0.000	0.000	2.141	0.000	2.141	0.000	0.000	0.000	0.000	0.000	2.141
• 0602131M: <i>MARINE CORPS LANDING FORCE TECHNOLOGY</i>	8.698	7.278	8.981	0.000	8.981	7.219	3.648	1.155	0.000	0.000	36.979
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603640M: <i>MC Advanced Technology Demo</i>				<b>PROJECT</b> 2297: <i>Marine Corps Warfighting Lab - Core</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2297: <i>Marine Corps Warfighting Lab - Core</i>	35.475	36.419	37.002	0.000	37.002	40.651	43.295	44.278	45.194	Continuing	Continuing

## **A. Mission Description and Budget Item Justification**

Marine Corps Warfighting Laboratory (MCWL) examines lessons learned from current operations, explores emerging threats and opportunities, and explores Joint and emerging service concepts through concept-based experimentation in order to enhance current and future warfighting capabilities. The use of modeling and simulation (M&S), both conducted within Service wargaming and virtual experiment venues (conducted in partnership with the Navy and Joint Forces Command (JFCOM)), will provide both a necessary Joint context for the Marine Corps Expeditionary Force Development System process as well as the opportunity to explore the implications of proposed future programs on seabased power projection capabilities.

"Live experimentation" permits exploration of prototype and surrogate technologies, as well as Tactics, Techniques, and Procedures (TTPs), in order to better refine equipment requirements and to identify Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) initiatives needed to produce future capabilities. Experimentation encompasses inquiries into multiple warfighting areas, including: Command, Control, Communications, and Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); Fires, Targeting, and Maneuver; Combat Service Support (CSS) and Force Protection; and Warfighting Excellence.

Using operational forces, MCWL conducts Advanced Warfighting Experiments (AWEs) supported by Limited Objective Experiments (LOEs), Limited Technical Assessments (LTAs), Wargames, and Studies. AWEs, LOEs, and LTAs examine discrete variables in as much isolation as can be achieved. Technologies assessed in LTAs are incorporated in LOEs while LOEs are building blocks from which resulting AWE-level campaigns are constructed. These campaigns (e.g., the Sea Viking (SV) experimentation series) are executed under the guidance of the Commandant of the Marine Corps (CMC) and in support of the Marine Air-Ground Task Force (MAGTF) Requirements List (MRL). The following provides an overview of MCWL experimentation:

- The Enhanced Company Operations (ECO) experiment series represents a major evolution in Marine infantry company operations. In the extended battlespace encountered in current and future operations, companies are required to execute functions normally conducted at battalion level and higher. ECO seeks to investigate structure, TTPs, training and equipment that will enable companies to effectively conduct full spectrum combat operations across an extended battlespace. ECO also seeks to use computer based simulation systems to expand the training opportunities and mission rehearsal capabilities.

- MCWL experimentation in FY 2010 and beyond will continue to address the broad challenges of seabased expeditionary warfare focused on the tactical levels. Specific areas of interest are reflected in the projects listed below which deal with outcomes impacting today's Marine Corps, the next Marine Corps, and Marine Corps after next.

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In FY 2011, MCWL experimentation will initiate an examination of Enhanced MAGTF Operations (EMO) that fully exploit capabilities achieved in ECO experimentation to the greater MAGTF beyond the infantry company focus of the past in the areas of C4, ISR, CSS, Fires, Targeting, and Maneuver. Additionally, FY 2011 investments will continue to support the immediate needs of deployed forces and exploit opportunities presented by emerging technologies.						
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
COMBAT SERVICE SUPPORT (CSS) AND FORCE PROTECTION		6.480	4.937	4.902	0.000	4.902
<p>This activity includes MCWL CSS and force protection experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced capabilities. Although this category covers several small (less than \$500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact.</p> <p>The decrease in funding from FY 2009 to FY 2010 is due to the completion of the Improvised Explosive Device (IED) Detector Dog Extended User Evaluation (EUE) and immediate cargo Unmanned Aerial Systems (UAS)demonstration efforts.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued to develop and experiment with bio-science (medical) technologies.</li><li>- Continued experimentation of simulation based training technologies to enhance small unit leader decision-making ability (transitions to Warfighting Excellence activity in FY 2010).</li><li>- Completed Mine Counter Measures (MCM)/Counter-IED efforts for mine and IED clearance, detection, and neutralization.</li><li>- Completed IED Detector Dog EUE.</li><li>- Completed development and experimentation with logistics-related equipment tailored to requirements of ECO.</li><li>- Completed development and experimentation with concept demonstrators that enable distribution of material from the seabase to small, widely dispersed, units ashore.</li></ul>						

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B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<div><div>- Initiated assessment of unmanned ground logistics delivery technologies that support infantry small unit operations.</div><div>- Initiated and completed technology demonstrations in immediate cargo Unmanned Aerial Systems (UAS).</div></div> <div><div>FY 2010 Plans:</div><div><div>- Continue all efforts of FY 2009, less those noted as completed above.</div><div>- Initiate assessment of technologies for sustainment of tactical level units from the sea-base.</div><div>- Initiate new investigations into point-of-wound stabilization and emerging technologies that support casualty evacuation (CASEVAC)/casualty extractions using robots.</div></div></div> <div><div>FY 2011 Base Plans:</div><div><div>- Continue all efforts of FY 2010.</div></div></div>					
<div>FIRES, TARGETING, AND MANEUVER</div> <div><div>This activity includes MCWL experimentation efforts in the areas of fires, targeting, and maneuver including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced capabilities. Although this category covers several small (less than \$500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact.</div></div> <div><div>FY 2009 Accomplishments:</div><div><div>- Continued evaluation of alternative counter shooter technologies.</div><div>- Completed development and assessment of Heavy Machine Gun Initiative (HMGI), an effort to design advanced mounts for United States Marine Corps (USMC) crew served weapons.</div></div></div>	1.447	1.587	1.648	0.000	1.648

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued C4 related small unit enhancements against irregular forces, including urban terrain.</li><li>- Initiated and completed C4 support for ECO experiments.</li><li>- Initiated and completed experimentation of enhanced communications concept demonstrators as part of ECO.</li><li>- Initiated and completed development and assessment of a voice-to-voice automated language translator concept demonstrator.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Complete C4 related small unit enhancements against irregular forces, including urban terrain.</li><li>- Initiate assessment of network management systems for Capability Set (CAPSET) V (all C2 below Battalion) networks.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li><li>- Complete experimentation of concept demonstrators to support company and below alternative C2 architectures.</li><li>- Complete assessment of network management systems for CAPSET V(all C2 below Battalion) networks.</li><li>- Initiate assessment of fuzzy logic (artificial intelligence based) network management systems.</li><li>- Initiate assessment of non-Radio Frequency based communications systems.</li></ul>						
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)  This activity includes MCWL ISR related experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced ISR capabilities. Although this category covers several small (less than \$500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact.		5.345	5.358	4.974	0.000	4.974

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued additional IED investigations into promising detect and neutralize technologies.</li><li>- Continued experimentation with TTPs and payloads for a Tier II Unmanned Aerial System (UAS) concept demonstrator to provide persistent ISR at regimental and battalion level.</li><li>- Continued efforts to develop the TTPs required for small infantry units to employ Unmanned Ground Vehicles (UGVs), UASs, and unattended ground sensors.</li><li>- Completed experimentation with the Small Unit Surveillance System (SUSS) and the Mobile Wearable Computer (MOWC).</li><li>- Initiated and completed development and experimentation with a networked suite of small unit disposable sensors to enhance small unit force protection.</li><li>- Initiated development and experimentation with a system that integrated tactical human intelligence collection, fusion, and visualization tools.</li><li>- Initiate assessment of an integrated company level C4 ISR network.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.</li><li>- Initiate investigations into rotary wing/hovering tactical level UAS concept demonstrators.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010.</li><li>- Complete experimentation with TTPs and payloads for a Tier II UAS concept demonstrator to provide persistent ISR at regimental and battalion level.</li><li>- Complete assessment of an integrated company level C4ISR network.</li><li>- Complete development and experimentation with a system that integrates tactical human intelligence collection, usion, and visualization tools.</li></ul>						
MARINE CORPS WARFIGHTING LABORATORY (MCWL) OPERATIONS (SUPPORT)		8.110	8.428	8.851	0.000	8.851

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MCWL Operations (Support) efforts include overall MCWL experimentation doctrine, planning, analysis, data collection, as well as technology transition tracking efforts. Although this category covers several small (less than \$500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact.  FY 2009 Accomplishments: - Continued to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps. - Continued to provide technical, strategic, and managerial support to Marine Corps experimentation. - Continued to provide overall analysis and reporting of experimentation efforts, analytical assistance during experiment design, and maintenance of an ad-hoc analysis capability. - Provided Acquisition Workforce support.  FY 2010 Plans: - Continue all efforts of FY 2009.  FY 2011 Base Plans: - Continue all efforts of FY 2010.						
WARFIGHTING EXCELLENCE  This activity includes MCWL efforts in the development and assessment of joint and service warfighting concepts, joint and service missions, analysis of emerging threats and opportunities, and joint capability experimentation. It also includes MCWL service experimentation in areas that impact multiple warfighting functions. Although this category covers several small (less than \$500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at \$500K or more) or have near-real-time operational impact. FY 2010 and beyond funding was realigned from CSS and Force Protection area in support of experimentation of simulation based training technologies.		4.936	6.639	6.842	0.000	6.842

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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued executive agent responsibilities for Joint Title X programs, such as Unified Quest, Unified Course, and Unified Engagement. Title X war games address future capabilities in the context of Title X readiness responsibilities.</li><li>- Continued management and oversight of non-Title X Wargaming, including the highly visible Office of the Secretary of Defense Net Assessment Transformation War Game series and the Special Operations Command wargaming series.</li><li>- Continued to conduct quarterly Emerald Express seminars that resulted in collection and dissemination of insights and observations from the Operating Forces. Produced reports for the purpose of professional military education and advancing the lessons-learned process.</li><li>- Continued to support the Center for Emerging Threats and Opportunities (CETO) mission: 1) prevent operational and tactical surprises to senior Warfighting Commanders by assessing future security environments in light of emerging threats and potential conceptual and technological opportunities; 2) help focus science, technology, and experimental efforts by appraising promising concepts and technologies; 3) serve as a catalyst to stimulate thought and debate on issues of importance to the Marine Corps.</li><li>- Continued funding contributions to Joint Concept Technology Demonstrations (JCTDs) and Advanced Concept Technology Demonstrations (ACTDs). Both JCTDs and ACTDs are intended to rapidly field needed capabilities by using emergent mature technologies matched with innovative operational concepts.</li><li>- Continued technology assessment and operational evaluation of Defense Advanced Research Projects Agency (DARPA)-developed robotic prototypes in support of ECO experimentation.</li></ul> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009, less those noted as completed above.- Continue experimentation of simulation based training technologies to enhance small unit leader decision-making ability (transitions from CSS activity).</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy				<b>DATE:</b> February 2010		
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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>						
		<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<p>- Initiate a MCWL-DARPA partnership for the development and demonstration of a legged robot in an effort to "Lighten the Load". Due to urgent operational commitments, driven by Operation Enduring Freedom, the Marine Corps will initiate a partnership with DARPA, beginning in FY2010, for the development and demonstration of a legged robot in an effort to "Lighten the Load" of the individual Marine. The MCWL-DARPA partnership represents an expansion of a large body of ongoing technical work aimed at a reduction in the base weight of the equipment, providing modular protection, enhancing warfighter mobility and improving load carriage to reduce fatigue and improve perceived weight.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all efforts of FY 2010.</p>						
Accomplishments/Planned Programs Subtotals		35.475	36.419	37.002	0.000	37.002
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A						
<b>D. Acquisition Strategy</b> N/A						
<b>E. Performance Metrics</b> The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
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<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	9.056	23.122	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	94.554
<b><u>A. Mission Description and Budget Item Justification</u></b> Congressional Interest Items not included in other Projects.											
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: California Central Coast Partnership Research <i>FY 2010 Plans:</i> This effort supports California Central Coast Partnership Research.							0.000	2.788			
Congressional Add: Enhanced Small Arms Protective Insert <i>FY 2010 Plans:</i> This effort supports Enhanced Small Arms Protective Insert research.							0.000	1.593			
Congressional Add: Future Immersive Training <i>FY 2010 Plans:</i> This effort provides for improvements to the Future Immersive Training Environment (FITE) an interoperable & reconfigurable hardware and software integrated training capability that enables the warfighter to train to accomplish close combat tasks in a realistic, fully immersive training environment that creates and reinforces complex (tactical and human dimension) decision making skills. Funding was transferred to this PE for FY 2010 from Operations and Maintenance, Navy line number 1C6C Combat Support Services in the FY 2010 Defense Appropriations Act.							0.000	9.480			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
- Continue support and improvement to the Future Immersive Training Environment (FITE) Joint Concept Technology Demonstration during FY 2010.		
Congressional Add: CRAFT INTEGRATED ELECTRONIC SUITE (CIES)  <i>FY 2009 Accomplishments:</i> This add continues to demonstrate the value of an integrated system for craft control and all C4ISR functions. CIES was first installed on the SEA LION II, where after an evaluation period, it has become an active combatant craft operated by SOCOM. The second system was delivered to SOUTHCOM in late FY2008 and a six week evaluation period was completed with highly successful results. This add continues that evaluation and provides a third system for installation installed on the Guardian. Additional ISR capabilities, including biometrics, have been incorporated into the design for use by Naval Forces.	2.872	0.000
Congressional Add: MARINE AIR-GROUND TASK FORCE SITUATIONAL AWARENESS  <i>FY 2009 Accomplishments:</i> This 2009 Congressional add is for the development of capability using Unmanned Systems for persistent Intelligence Surveillance Reconnaissance (ISR) as a part of the Navy Expeditionary Overwatch (NEO) system-of-systems. These systems include the Nighthawk USV, Gunslinger HMMWV and the Scan Eagle UAV. This integration of unmanned vehicle mission management capability supports the NEO Program and continues the integration of data between the Common Operational Picture (COP) and unmanned platforms.  <i>FY 2010 Plans:</i> This effort supports Marine Air-Ground Task Force situational Awareness research.	0.997	2.689
	1.197	0.000

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Congressional Add: Ballistic Helmet Development  <i>FY 2009 Accomplishments:</i> The goal of the Ballistic Helmet Development add is demonstrating various levels of protection for a lightweight small arms protective helmets able to defeat small arms fire. A contract award has been completed. The work is focused on functional areas of materials, ballistics and helmet manufacturing with end state goal of demonstrating a ballistic shell capable against a specific threat. The maximum areal densities for each variant will be specified and in-line with desired weight bogeys. The same general form factor as the current Marine Light Weight Helmet LWH (complex shape, suspension system, area of coverage, shell/cranium standoff, etc.) will be utilized. Armor material and systems will be validated through ballistic coupon testing as an interim deliverable prior to helmet shell fabrication. It is anticipated that approximately 10 helmets for each design will be delivered to the government for independent verification of performance. Ballistic verification testing, areal density and weight measurements will be performed by the US Army Aberdeen test center.		
Congressional Add: Ground Warfare Acoustical Combat System of Netted  <i>FY 2009 Accomplishments:</i> This effort will investigate cost effective, light weight, man wearable shot/fire event detection systems that enable quick response to direct shots or indirect fire from snipers, front line combatants, or other field assets. The Marine Corps Warfighting Laboratory (MCWL) will conduct proof of concept experimentation with GWACS in order to determine its utility within a Marine Corps rifle squad.  <i>FY 2010 Plans:</i> This effort will investigate cost-effective, light weight, man-wearable shot/fire event detection systems that enable quick response to direct shots or indirect fire from snipers, front line combatants, or other field assets. Pending results of ongoing FY09 Congressionally-funded efforts, the Marine Corps	1.995	4.979

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<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
Warfighting Laboratory (MCWL) will conduct proof of concept experimentation with GWACS and/or other GWACS-type system(s) in order to determine the concept's utility within a Marine Corps rifle unit.		
Congressional Add: Near Infrared optical (NIRO) Augmentation System  <i>FY 2009 Accomplishments:</i> The Near Infrared Optical (NIRO) Augmentation System will detect surveillance and targeting activities such as snipers and cameras by detection of the spectral return when illuminated. The effort is focused on functional areas of lasers, image intensifiers, and automated image analysis with the end goal of demonstrating various implementations of detection capabilities for the Marine Corps.  <i>FY 2010 Plans:</i> This effort supports Near Infrared Optical Augmentation System research.	0.798	1.593
Congressional Add: Hybrid Capacitor Supercell for Marine Combat Vehic  <i>FY 2009 Accomplishments:</i> This FY2009 Congressional add is developing a new power source that merges the best qualities of a battery (energy) with those of a supercapacitor (power). The Hybrid Capacitor Supercell may allow the Marine Corps to replace the heavy, lead acid battery in their vehicles with a new, more reliable and less temperature dependant energy source that will likely be 25-40% lighter. Initial cost targets are only 2 to 3 times the cost of the existing lead acid batteries, compared to 8 to 10 times for li-ion and NiMH, because the new Hybrid Capacitor Supercell construction and manufacturing techniques are closely aligned with conventional lead acid battery production. The add is executing in accordance with Congressional intent.	1.197	0.000
Congressional Adds Subtotals	9.056	23.122

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<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		



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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603651M: JT Non-Lethal Wpns Tech Dev							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	13.475	11.749	11.131	0.000	11.131	11.384	11.686	11.936	12.180	Continuing	Continuing
3022: Joint Non Lethal Weapons	11.875	10.952	11.131	0.000	11.131	11.384	11.686	11.936	12.180	Continuing	Continuing
9999: Congressional Adds	1.600	0.797	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.397

**A. Mission Description and Budget Item Justification**

The DOD's Joint Non-Lethal Weapons Program (JNLWP) was established by the Secretary of Defense, who assigned centralized responsibility for DOD joint research and development of non-lethal technology to the Commandant of the Marine Corps as the Executive Agent. The Under Secretary of Defense for Acquisition, Technology and Logistics provides direct oversight of the JNLWP.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions provided by the Joint NLW Integrated Product Team, a multi-service flag level corporate board that executes the JNLWP for the Commandant of the Marine Corps. This direction is based on the needs and capabilities of the Services, the Special Operations Command, and the Coast Guard, as identified in the DoD's Non-Lethal Weapons Joint Capabilities Based Assessment Document. This coordinated joint S&T development approach addresses mutual capability gaps and assures the best non-lethal technologies and equipment are provided to the operating forces while eliminating duplicative service S&T investment.

This program funds the research and development of next-generation Non-Lethal Weapons (NLWs) and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponization and use of these NLWs. Next-generation NLW systems focus on long-range localized Non-Lethal (NL) effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, vessels, and also in close proximity to high-value civilian facilities. By order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, the Marine Corps is established as the Executive Agent for DoD Joint Non-Lethal Weapons RDT&E.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		PE 0603651M: JT Non-Lethal Wpns Tech Dev			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	12.984	10.998	0.000	0.000	0.000
Current President's Budget	13.475	11.749	11.131	0.000	11.131
Total Adjustments	0.491	0.751	11.131	0.000	11.131
• Congressional General Reductions		-0.049			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		0.800			
• Congressional Directed Transfers		0.000			
• Reprogrammings	2.797	0.000			
• SBIR/STTR Transfer	-0.311	0.000			
• Program Adjustments	0.000	0.000	11.131	0.000	11.131
• Congressional Recision Adjustments	0.005	0.000	0.000	0.000	0.000
• Congressional Add Adjustments	-2.000	0.000	0.000	0.000	0.000
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Eye Safe Laser Warning Systems					
Congressional Add: ADS Planar Scanning Ant Sys					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603651M: <i>JT Non-Lethal Wpns Tech Dev</i>				<b>PROJECT</b> 3022: <i>Joint Non Lethal Weapons</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
3022: <i>Joint Non Lethal Weapons</i>	11.875	10.952	11.131	0.000	11.131	11.384	11.686	11.936	12.180	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project funds the research and development of next-generation NLWs and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponization and use of these NLWs. Investment areas include research and development of next-generation NLWs such as: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-material missions; non-lethal counter-personnel technologies (acoustic, optical, and human electro-muscular disruption technologies), and advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications). Next-generation NLW systems focus on long-range localized NL effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, vessels, and also in close proximity to high-value civilian facilities.

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
JOINT NON-LETHAL WEAPONS	11.875	10.952	11.131	0.000	11.131
<b><i>FY 2009 Accomplishments:</i></b> <ul style="list-style-type: none"> <li>- Continued effort to assess the general utility, effect, and effectiveness of technologies for incapacitating personnel, clearing facilities, stopping vehicles and vessels, and denying enemy access to protected areas.</li> <li>- Continued design of a man-transportable laser weapons system that can be used for non-lethal counter-personnel or non-lethal counter-materiel applications through ultra-high precision engagement of selected targets with minimal collateral damage.</li> <li>- Continued research to define the optimum approaches, technologies and tactics necessary to clear a facility/building with and without entry.</li> <li>- Continued characterization of bioeffects induced via acoustic non-lethal weapon concepts.</li> <li>- Continued modeling/research to develop an understanding of the complex relationships between individual, group and crowd dynamics in order to predict the macro effects of NLWs. Specifically,</li> </ul>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603651M: JT Non-Lethal Wpns Tech Dev		PROJECT 3022: Joint Non Lethal Weapons		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
investigate factors that cause crowds to move to violent behavior, and what non-lethal technologies will be effective in controlling or mitigating violent crowd behavior. - Continued effort to examine and optimize non-lethal effects and effectiveness of various non-lethal stimuli, to include light, acoustics, electrical, high power laser, high power microwave and active denial technology. Research includes human effects analysis with respect to existing non-lethal stimuli and other emerging system stimuli to characterize behaviors and their operational relevance. - Continued non-lethal effects characterization through modeling and effects testing using the Advanced Total Body Model. - Continued prototype development and demonstration of the most promising candidate technologies employing multi-sensory stimuli. - Continued investigations of technology advancements to miniaturize proven non-lethal weapon prototypes /demonstrators to enable their transition to tactically relevant, cost effective capabilities in the field. - Completed demonstration and transition of the most effective vehicle/vessel stopping technologies to higher categories of development/acquisition. - Completed demonstration and transition of the most effective directed energy technologies with counter-personnel and counter-materiel applications to higher categories of development/acquisition. - Initiated prototype development of advanced payloads for candidate technological capabilities with applications relevant to emerging capability gaps. - Initiated prototype development and demonstration of the most promising candidate technologies addressing the extended range/duration incapacitation capability gap.						
Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund.						
FY 2010 Plans: - Continue all efforts from FY 2009, less those noted as completed above. - Complete characterization of bioeffects induced via acoustic non-lethal weapon concepts.						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603651M: JT Non-Lethal Wpns Tech Dev		PROJECT 3022: Joint Non Lethal Weapons		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Initiate transition to higher levels of development and demonstration for the most promising candidate technologies employing multi-sensory stimuli.</p> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all efforts from FY 2010, less those noted as completed above.</li><li>- Complete design of a man-transportable laser weapons system that can be used for non-lethal counter-personnel or non-lethal counter-materiel applications through ultra-high precision engagement of selected targets with minimal collateral damage. This effort was discontinued during FY09 based on ineffective results demonstrated during counter-personnel laser in-field testing. The counter-materiel application no longer meets the NLW definition per the JROC-approved Non-Lethal Effects Joint Capabilities Document (JCD).</li><li>- Continue to address non-lethal counter-personnel capability gaps with alternative directed energy technologies.</li><li>- Complete investigations of technology advancements to miniaturize proven non-lethal weapon prototypes/ demonstrators to enable their transition to tactically relevant, cost effective capabilities in the field.</li><li>- Complete prototype development and demonstration of the most promising candidate technologies employing multi-sensory stimuli and transition best candidates to higher levels of technology development and demonstration.</li><li>- Initiate transition to higher levels of technology development and demonstrate the most promising directed energy technologies under consideration for counter-personnel and counter-material applications.</li><li>- Initiate technology development employing optimized electro-muscular disruption waveforms and mechanisms for an extended duration counter-personnel suppression capability.</li></ul>						
Accomplishments/Planned Programs Subtotals		11.875	10.952	11.131	0.000	11.131

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603651M: <i>JT Non-Lethal Wpns Tech Dev</i>	<b>PROJECT</b> 3022: <i>Joint Non Lethal Weapons</i>
<p><b>C. Other Program Funding Summary (\$ in Millions)</b> N/A</p> <p><b>D. Acquisition Strategy</b> N/A</p> <p><b>E. Performance Metrics</b>  The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons which address identified and prioritized joint NLW capability gaps. The program consists of a collection of projects for the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, mitigation of high priority joint NLW capability gaps, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010															
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603651M: <i>JT Non-Lethal Wpns Tech Dev</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>															
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>												
9999: <i>Congressional Adds</i>	1.600	0.797	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.397												
<p><b><u>A. Mission Description and Budget Item Justification</u></b>  Congressional Interest Items not included in other Projects.</p> <p><b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 20%; text-align: center;">FY 2009</th> <th style="width: 20%; text-align: center;">FY 2010</th> </tr> </thead> <tbody> <tr> <td> Congressional Add: Eye Safe Laser Warning Systems  <i>FY 2010 Plans:</i>  This effort supports Dynamic Eye-Safe Imaging Laser research. </td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">0.797</td> </tr> <tr> <td> Congressional Add: ADS Planar Scanning Ant Sys  <i>FY 2009 Accomplishments:</i>  The Active Denial Planar Scanner Antenna System Congressional add funds the Joint Non Lethal Weapons Program's development and demonstration of a compact millimeter-wave planar scanner antenna as an Active Denial Weapon subsystem capability. </td> <td style="text-align: center;">1.600</td> <td style="text-align: center;">0.000</td> </tr> <tr> <td style="text-align: right;">Congressional Adds Subtotals</td> <td style="text-align: center;">1.600</td> <td style="text-align: center;">0.797</td> </tr> </tbody> </table> <p><b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>  N/A</p> <p><b><u>D. Acquisition Strategy</u></b>  N/A</p>													FY 2009	FY 2010	Congressional Add: Eye Safe Laser Warning Systems <i>FY 2010 Plans:</i> This effort supports Dynamic Eye-Safe Imaging Laser research.	0.000	0.797	Congressional Add: ADS Planar Scanning Ant Sys <i>FY 2009 Accomplishments:</i> The Active Denial Planar Scanner Antenna System Congressional add funds the Joint Non Lethal Weapons Program's development and demonstration of a compact millimeter-wave planar scanner antenna as an Active Denial Weapon subsystem capability.	1.600	0.000	Congressional Adds Subtotals	1.600	0.797
	FY 2009	FY 2010																					
Congressional Add: Eye Safe Laser Warning Systems <i>FY 2010 Plans:</i> This effort supports Dynamic Eye-Safe Imaging Laser research.	0.000	0.797																					
Congressional Add: ADS Planar Scanning Ant Sys <i>FY 2009 Accomplishments:</i> The Active Denial Planar Scanner Antenna System Congressional add funds the Joint Non Lethal Weapons Program's development and demonstration of a compact millimeter-wave planar scanner antenna as an Active Denial Weapon subsystem capability.	1.600	0.000																					
Congressional Adds Subtotals	1.600	0.797																					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	R-1 ITEM NOMENCLATURE PE 0603651M: <i>JT Non-Lethal Wpns Tech Dev</i>	PROJECT 9999: <i>Congressional Adds</i>
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		



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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>	<b>DATE:</b> February 2010
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603729N: <i>Warfighter Protection Adv Tech</i>
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<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
Total Program Element	52.711	51.893	18.076	0.000	18.076	18.379	24.262	23.234	28.038	Continuing	Continuing
2914: <i>Warfighter Protection Adv Tech</i>	11.024	18.532	18.076	0.000	18.076	18.379	24.262	23.234	28.038	Continuing	Continuing
9999: <i>Congressional Adds</i>	41.687	33.361	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	190.888

**A. Mission Description and Budget Item Justification**

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not product development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection program a Future Naval Capability (FNC) that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0603729N: Warfighter Protection Adv Tech			
BA 3: Advanced Technology Development (ATD)					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	53.766	18.609	0.000	0.000	0.000
Current President's Budget	52.711	51.893	18.076	0.000	18.076
Total Adjustments	-1.055	33.284	18.076	0.000	18.076
• Congressional General Reductions		-0.216			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		33.500			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-0.785	0.000			
• SBIR/STTR Transfer	-0.270	0.000			
• Program Adjustments	0.000	0.000	18.076	0.000	18.076
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds				FY 2009	FY 2010
Congressional Add: Naval Special Warfare Performance and Injury Prevention Program				0.000	1.992
Congressional Add: CW Bill Young Marrow Donor Program				31.415	31.369
Congressional Add: INTEGRATED WARFIGHTER BIODEFENSE PROGRAM				2.992	0.000
Congressional Add: MASSIVE TISSUE INJURY/AMPUTATION REPAIR WITH COMPO				3.191	0.000
Congressional Add: Amelioration of Hearing Loss				0.997	0.000
Congressional Add: High Speed Blood and Fluid Transfusion Equipment				3.092	0.000
Congressional Add Subtotals for Project: 9999				41.687	33.361
Congressional Add Totals for all Projects				41.687	33.361
Change Summary Explanation					
Technical: Not applicable.					

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N: Warfighter Protection Adv Tech	
<p>Schedule: Not applicable.</p> <p>FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.</p>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603729N: <i>Warfighter Protection Adv Tech</i>				<b>PROJECT</b> 2914: <i>Warfighter Protection Adv Tech</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2914: <i>Warfighter Protection Adv Tech</i>	11.024	18.532	18.076	0.000	18.076	18.379	24.262	23.234	28.038	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The NIH focuses on the basic science of disease processes and not product development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection program a Future Naval Capability (FNC) that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

**B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>BONE MARROW RESEARCH</b>	0.000	0.943	0.000	0.000	0.000
<p>The goal of the Bone Marrow program is to test, develop and evaluate military contingency capabilities in order to improve care for casualties of marrow-toxic substances. This program will research efforts to refine and correctly identify matched marrow and matched platelets for casualties as well as military members with medical injuries including combat trauma. FY 2010 initiate and complete the Bone Marrow Research.</p> <p><i>FY 2010 Plans:</i></p> <ul style="list-style-type: none"> <li>- Initiate and complete the Bone Marrow Research.</li> </ul>					
<b>CASUALTY CARE AND MANAGEMENT</b>	6.950	5.489	5.287	0.000	5.287

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603729N: Warfighter Protection Adv Tech		PROJECT 2914: Warfighter Protection Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The goal of Casualty Care and Management is to maximize the continuum of care with lifesaving interventions as close to the battlespace as possible. This is in an increasingly lethal battlespace, with reduced infrastructure and logistics.</p> <p>The decrease in funding from FY 2009 to FY 2010 is due to the completion of the Medical Planning Tools and Repetitive Neurotrauma (RNT). FNC efforts in this area, and the realignment of the Post Traumatic Stress Disorder Mitigation. FNC efforts into the Casualty Prevention activity of this PE.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued study to demonstrate selectivity/specificity of biomarkers for mild &amp; moderate RNT in appropriate pre-clinical model.</li><li>- Continued efforts to develop advanced technologies for First Responders.</li><li>- Continue efforts to develop advanced technologies to support the Forward Resuscitative Surgical System/ Expeditionary Resuscitative Surgical Systems (FRSS/ERSS).</li><li>- Continued program to develop advanced technologies to support En Route Care of casualties.- Continued preclinical study to evaluate use of vasopressin to manage traumatic brain injury (TBI).</li><li>- Continued development of casualty management tools and data. These tools and data are required by combat, material development and medical planners to evaluate the effectiveness of personal protection systems and healthcare support services, and to project future material and training requirements.</li><li>- Continued clinical trial evaluating safety of vasopressin for treatment of trauma patients.</li><li>- Continued efforts to develop a novel fibrinogen-like bandage using nanotechnology for hemorrhage control (internal and external).</li><li>- Continued efforts to develop prototype technology for closed-loop resuscitation for USMC En Route Care system.</li><li>- Continued program to examine comorbidity of traumatic brain injury. (Continuation of similar effort funded in Healthy and Fit Force activity of this PE prior to FY 2009.)</li><li>- Completed preclincial study to evaluate use of vasopressin to manage RNT.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603729N: Warfighter Protection Adv Tech		PROJECT 2914: Warfighter Protection Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed development of casualty management tools and data. These tools and data are required by combat, material development and medical planners to evaluate the effectiveness of personal protection systems and healthcare support services, and to project future material and training requirements.</li><li>- Completed efforts to develop prototype technology for closed-loop resuscitation for USMC En Route Care system.</li><li>- Completed Breacher study efforts at the Dynamic Entry School/Quantico a component of the FRSS/ERSS.</li><li>- Completed preclinical study to evaluate use of vasopressin to manage traumatic brain injury (TBI).</li><li>- Completed remaining project to enhance medical planning tools for combat developers.</li><li>- Initiated efforts to treat the psychological manifestations' of combat stress.</li><li>- Initiated pharmacologic research studies to support an FDA Investigational New Drug (IND) application.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009 less those noted as completed above.</li><li>- Continue efforts to develop advanced technologies to support Rapid Blood Treatment. (Previously identified as First Responder in FY09 in this activity)</li><li>- Continue efforts to develop advanced technologies to support Advanced Forward Care. (Previously identified as FRSS/ERSS in FY09 in this activity)</li><li>- Continue efforts to develop advanced technologies to support Warfighter Restoration. (Previously identified as En Route Care in FY09 in this activity)</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010 less those noted as completed above.</li><li>- Initiate development of multifunctional blood substitute program.</li></ul>						
CASUALTY PREVENTION		4.074	5.947	7.186	0.000	7.186

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603729N: Warfighter Protection Adv Tech		PROJECT 2914: Warfighter Protection Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Casualty Prevention includes protecting the warfighter from environmental, occupational and battlefield threats.						
The increase in funding from FY 2009 to FY 2011 is due to the initiation of emerging technologies that support delivery of approved FNC enabling capabilities and to increased investments for Post Traumatic Stress Disorder Treatment FNC efforts in this activity.						
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued efforts to mitigate the effects of environmental and other threats to health.</li><li>- Continued efforts to reduce operational injuries.</li><li>- Continued research to determine the safety and efficacy of perfluorocarbons in treating decompression sickness and arterial gas embolism. (Realigned from Healthy and Fit Force activity of this PE after 2008.)</li><li>- Completed safety studies and analysis of compartmental shipboard heat exposure levels.</li><li>- Completed head-neck blast effects computational representation and experimental surrogate; operational injury.</li><li>- Initiated development of tools to prevent psychological stress and PTSD. (Continuation of similar effort funded in Healthy and Fit Force activity of this PE prior to FY 2009.)</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2009.</li><li>- Continue efforts to model head and neck injuries due to accelerated forces; operational injuries.</li><li>- Initiate research to enhance force readiness by mitigating the impact of environmental stressors.</li><li>- Initiate development of Human Injury and Treatment (HIT) model to assess personnel survivability, optimal personnel treatment, and restoration of ship operational capabilities.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all efforts of FY 2010, less those noted as completed above.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603729N: Warfighter Protection Adv Tech		PROJECT 2914: Warfighter Protection Adv Tech		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete research to determine the safety and efficacy of perfluorocarbons in treating decompression sickness and arterial gas embolism.						
NAVAL NOISE-INDUCED HEARING LOSS (NIHL)  The goal of this program is to reduce the incidence of NIHL by nearly 100%. This program employs a total systems engineering approach that includes advancements in medical technology, jet engine physics, personal protective equipments, and mitigation analyses. Similar/related research was previously funded within this PE.  This is a new effort in FY 2010 in support of applied research efforts.  FY 2010 Plans: - Initiate advanced research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears). - Initiate advanced research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction. - Initiate advanced research to improve personal protective equipment technology. - Initiate advanced research to study the incidence and susceptibility of NIHL and tinnitus, and to evaluate mitigation strategies.  FY 2011 Base Plans: - Continue all efforts of FY 2010.		0.000	6.153	5.603	0.000	5.603
Accomplishments/Planned Programs Subtotals		11.024	18.532	18.076	0.000	18.076

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603729N: Warfighter Protection Adv Tech				PROJECT 2914: Warfighter Protection Adv Tech			
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0602236N: WARFIGHTER PROTECTION WARFIGHTER SUSTAINMENT APPLIED RESEARCH	3.770	5.059	6.220	0.000	6.220	5.996	4.447	2.268	0.565	0.000	28.325
D. Acquisition Strategy N/A											
E. Performance Metrics Efforts within this PE are measured at two levels. At the lower level, each is measured against technical and financial milestones on a monthly basis. Annually, each project is reviewed in depth for technical and transition performance by the Chief of Naval Research (CNR).											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603729N: <i>Warfighter Protection Adv Tech</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	41.687	33.361	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	190.888
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Naval Special Warfare Performance and Injury Prevention Program <i>FY 2010 Plans:</i> This effort supports Navy Special Warfare Performance and Injury Prevention Program for Special Boat Team 22 research.							0.000	1.992			
Congressional Add: CW Bill Young Marrow Donor Program <i>FY 2009 Accomplishments:</i> This effort supported the C. W. (Bill) Young Bone Marrow registry program.  <i>FY 2010 Plans:</i> Continues support of the C.W. Bill Young Bone Marrow Donor Recruitment and Research Program research.							31.415	31.369			
Congressional Add: INTEGRATED WARFIGHTER BIODEFENSE PROGRAM							2.992	0.000			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603729N: <i>Warfighter Protection Adv Tech</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This research supported the development of a framework for integrating health databases, sensor inputs, and distributed artificial intelligence, in order to detect and characterize likely threats, plan for logistical burden, and present viable plans for action in an intuitive framework that can be used by military planners with minimal instruction.		
Congressional Add: MASSIVE TISSUE INJURY/AMPUTATION REPAIR WITH COMPO  <i>FY 2009 Accomplishments:</i> This effort supported the development of advanced techniques for transplanting composite tissue (skin/tendon/bone) and organs (heart, kidney) with minimal or no immunosuppression. Research directly applies to the clinical care of military casualties with traumatic injuries.	3.191	0.000
Congressional Add: Amelioration of Hearing Loss  <i>FY 2009 Accomplishments:</i> This effort supported the amelioration of hearing loss program which serves to develop a treatment(s) to reverse noise-induced hearing loss by regenerating functional sensory cells in the cochlea. Research has attempted to: 1) Validate a working model of induced hair cell regeneration in the cochlea in a preclinical setting. 2) Examine the ability to use gene expression technology to re-grow functional cochlear hair cells in the guinea pig to restore hearing. 3) Transition animal data to begin the process for FDA approval. Note: Program utilizes animal models only and will not involve human testing.	0.997	0.000
Congressional Add: High Speed Blood and Fluid Transfusion Equipment	3.092	0.000

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603729N: <i>Warfighter Protection Adv Tech</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>		
	<b>FY 2009</b>	<b>FY 2010</b>
<i>FY 2009 Accomplishments:</i> This effort supported the development and demonstration of a new temperature-conditioning blood and fluids technology for infusion/transfusion that can be operated without electrical power, but instead uses high power density thermal energy storage technology.		
Congressional Adds Subtotals	41.687	33.361
<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A		
<b><u>D. Acquisition Strategy</u></b> N/A		
<b><u>E. Performance Metrics</u></b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	80.323	73.636	49.276	0.000	49.276	39.541	33.651	39.443	36.295	Continuing	Continuing
2916: Undersea Warfare Advanced Technology	77.929	67.660	49.276	0.000	49.276	39.541	33.651	39.443	36.295	Continuing	Continuing
9999: Congressional Adds	2.394	5.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23.949
A. Mission Description and Budget Item Justification											
<p>The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&amp;T Strategic Plan approved by the S&amp;T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&amp;T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.</p>											
<p>All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this PE. The related technologies being developed are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. The focus is on leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2011 Navy</b>				<b>DATE:</b> February 2010	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603747N: <i>Undersea Warfare Advanced Tech</i>			
<b>B. Program Change Summary (\$ in Millions)</b>					
	<b><u>FY 2009</u></b>	<b><u>FY 2010</u></b>	<b><u>FY 2011 Base</u></b>	<b><u>FY 2011 OCO</u></b>	<b><u>FY 2011 Total</u></b>
Previous President's Budget	83.565	68.037	0.000	0.000	0.000
Current President's Budget	80.323	73.636	49.276	0.000	49.276
Total Adjustments	-3.242	5.599	49.276	0.000	49.276
• Congressional General Reductions		-0.306			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.095			
• Congressional Adds		6.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-0.935	0.000			
• SBIR/STTR Transfer	-2.306	0.000			
• Program Adjustments	0.000	0.000	49.276	0.000	49.276
• Rate/Misc Adjustments	-0.001	0.000	0.000	0.000	0.000
<b><u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u></b>					
<b>Project: 9999: Congressional Adds</b>					
Congressional Add: <i>Underwater Explosives and Warhead Research</i>					
Congressional Add: <i>ASW Research Prog - Cong</i>					
Congressional Add: <i>Theater Undersea Warfare Initiative</i>					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
<b><u>Change Summary Explanation</u></b>					
Technical: Not applicable.					
Schedule: Not applicable.					
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603747N: <i>Undersea Warfare Advanced Tech</i>				<b>PROJECT</b> 2916: <i>Undersea Warfare Advanced Technology</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2916: <i>Undersea Warfare Advanced Technology</i>	77.929	67.660	49.276	0.000	49.276	39.541	33.651	39.443	36.295	Continuing	Continuing

## **A. Mission Description and Budget Item Justification**

All Navy advanced technology developments in undersea target detection, classification, localization, tracking and neutralization are funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

## **B. Accomplishments/Planned Program (\$ in Millions)**

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
ANTI-SUBMARINE WARFARE (ASW) DISTRIBUTED SEARCH	0.000	3.345	4.367	0.000	4.367
<p>ASW Distributed Search focuses the development of technologies for the non-covert tactical search for undersea targets ranging from hours to weeks using automated sensor systems deployed around operating areas including along key transit routes to protect naval/maritime forces, around temporarily fixed sea base regions and naval force operating areas, or around fixed defensive regions and areas of interest such as key US/Allied ports. "Non-covert" implies availability of airborne assets for sensor deployment (although other means may also be used), and the ability to employ active sonar along with passive and non-acoustic methods. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The submarine target must be detected beyond its weapons release range. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Distributed Search supports the ASW protected passage Maritime Shield operational constructs. Related efforts include the development of distributed systems employing optimization as well as active acoustic sensing and processing techniques, navy-unique transduction and underwater networking</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
technology. Efforts also include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components. These efforts provide an extended reach of organic platform-based systems through the use of new sensor concepts, improved materials for advanced sensors, optimized deployment, employment, and automated operation of distributed sensor fields. The cornerstone of Distributed Search is the development of rapidly deployable, long-endurance active sensors with automated processing suitable for use in a wide variety of operational environments.						
The FY 2009 to FY 2010 funding increase is due to the realignment of the Wide Area ASW Surveillance activity into this new activity.						
FY 2010 Plans: The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of Distributed Systems Processing (DSP) threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems. - Initiate development high fidelity computer-based simulation training with linked architecture that supports ASW training from the operator-level to the ASW Commander-level applicable to both surface and air platforms.						
FY 2011 Base Plans: - Continue FY 2010 efforts. - Complete development of DSP threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems. Technologies will transition to the Maritime Surveillance System Program Office, NAVSEA PMS 485.						
ANTI-SUBMARINE WARFARE (ASW) PERFORMANCE ASSESSMENT		0.000	6.417	4.347	0.000	4.347

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>The goal of this work is to integrate ocean and atmospheric environmental characteristics with sensor performance predictions in order to develop algorithms and Tactical Decision Aids (TDAs) that will accurately predict overall sensor performance in a given environment in near real-time for both present and future situations. The results of these research efforts in conjunction with embedded state-of-the-art command and operator-level training will facilitate the optimum employment of ASW sensor systems, thus increasing their effectiveness and potentially decreasing the number of sensors used to provide coverage in a given area. This work will provide operational commanders with sensor performance predictions which allow them to accurately judge the performance of those sensors, as well as information with which to deploy them for the greatest operational effect. It will also provide information as to how the performance evolves over time due to effects such as the deformation of sensor locations by currents, sound velocity profile changes, geologic magnetic interference changes, or changes to the optical properties of the water, etc. The effort includes performance predictions for fields of sensors as well as individual sensors themselves and applies to both acoustic and nonacoustic sensors.</p> <p>Work includes development of ASW sensor and system performance models, and realistic simulations and measures of effectiveness that incorporate and exploit critical environmental knowledge. It includes efforts to couple ocean dynamics and acoustics, characterize ambient noise in the littorals, measure and model acoustic and optical propagation and scattering in complex environments, develop algorithms to extract environmental information from through-the-sensor measurements and quantification and prediction of uncertainty. This information is combined with the operating characteristics of particular sensors (or groups of sensors) to provide predictions of sensor performance in the environment at that particular time and in the future. The predictions will also include assessments of the prediction uncertainty due to environmental measurement and sensor performance uncertainties.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>This work aligns principally with the Assure Access and Hold at Risk S&amp;T Focus Area in the Naval S&amp;T Strategic Plan and contributes measurably to the Operational Environments S&amp;T Focus Area strategic objectives.</p> <p>The FY 2009 to FY 2010 funding increase is due to the realignment of the Wide Area ASW Surveillance activity into this new activity.</p> <p><i>FY 2010 Plans:</i> The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity:</p> <ul style="list-style-type: none"><li>- Continue a research effort focusing on distributed system in-situational environmental characterization and system monitoring.</li><li>- Continue a research effort to determine the placement of and follow-on control and pattern keeping of acoustic sources and mobile distributed sensor systems.</li><li>- Continue research effort aimed at the ideal placement of acoustic sources and drifting sensor systems.</li><li>- Complete algorithm testing of uncontrolled drifting systems using a simulator. This effort transitioned from PE 0602747N in FY 2009.</li><li>- Complete test planning of source algorithms to be used to determine the optimal initial placement of uncontrolled drifting distributed systems.</li><li>- Complete development of algorithms to optimize the initial placement of uncontrolled drifting systems. This effort transitioned from PE 0602747N.</li><li>- Complete development of a simulator for placement of uncontrolled drifting systems. This effort transitioned from PE 0602747N in FY 2009. This effort is intended to transition to Program Executive Office Air ASW, Assault and Special Mission Programs (PMA-264). The agreement is being negotiated and the details will be entered after the TA is signed.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all FY 2010 efforts less those noted as complete above.						
ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE  ASW Surveillance focuses on dramatically improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of legacy ASW surveillance systems. The related technologies support the conduct of covert wide-area surveillance ranging from one day to six months. The objectives are to develop and demonstrate technologies that provide clandestine indications and warnings in far forward and contested operating areas and in complex operational environments against all submarine threats including new threats with unknown target signatures and tactics. Covertiness implies use of non-observable platforms and/or deployed automated sensors employing passive sonar or other non-detectable methods. The surveillance process includes initial detection and classification. Efforts include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing a wide variety of surveillance concepts and components. These efforts focus on alternative detection phenomena, vector/tensor sensors, automated acoustic processing, more compact and longer lasting power sources, and high bandwidth acoustic communications links.  The FY 2009 to FY 2010 funding increase is due to the realignment of the Wide Area ASW Surveillance activity into this new activity. The FY 2010 to FY 2011 funding decrease is due to the completion of Future Naval Capability (FNC) - SHD-FY06-02 - Deployable Autonomous distributed System (DADs); PALANTIR; and Submarine Track and Trail.  FY 2010 Plans: The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity:		0.000	44.406	33.516	0.000	33.516

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
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B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continue the On-Demand Detection Classification and Localization (ODDCL) effort focusing on the development of sensor and platform designs and key components compatible with a notional Concept of Operations.</li><li>- Continue system level design and integration for ODDCL.</li><li>- Continue development of a tactical area prototype system for Persistent Littoral Undersea Surveillance (PLUS).</li><li>- Continue a PLUS prototype system simulation test in preparation for FY 2011 at-sea experiments.</li><li>- Continue analysis of data collected during the FY 2010 PLUS at-sea experiments.</li><li>- Continue two at-sea experiments focused on increasing system persistence capabilities.</li><li>- Complete Submarine Track &amp; Trail (STT) Baseline advanced research efforts in the areas of advanced undersea sensors, communications, autonomy, and sensor data collection and analysis to support tracking algorithm and automated processing development.</li><li>- Complete DADS deployability, survivability and classification performance improvement effort.</li><li>- Complete testing of the Palantir (a non-acoustic surveillance system) sensor system.</li><li>- Complete tactical test planning for the Palantir sensor.</li><li>- Complete DADS at-sea classification performance improvement testing.</li><li>- Complete at-sea testing of integrated STT submersibles and evaluate overall system performance.</li><li>- Complete DADS deployability, covert communications and survivability testing.</li><li>- Complete at-sea demonstrations of STT submersible with fully integrated sensor package.</li><li>- Initiate system level integration and testing for ODDCL.</li><li>- Initiate development of a vector sensor towed array and associated signal processing with performance nominally equivalent to a "thin-line" (TB-29) twin-line towed array to be compatible with the existing TB-29 array handling system.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY10 less those noted as completed above.</li><li>- Complete a PLUS prototype system simulation test in preparation for FY 2011 at-sea experiments.</li><li>- Complete two at-sea experiments focused on increasing system persistence capabilities.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate a PLUS prototype system simulation test in preparation for FY 2012 at-sea experiments.</li><li>- Initiate analysis of data collected during the FY 2011 PLUS at-sea experiments.</li><li>- Initiate two at-sea experiments focused on increasing system adaptation and optimization capabilities.</li><li>- Initiate development of a vector sensor towed array and associated signal processing with performance nominally equivalent to a "thin-line" (TB-29) twin-line towed array to be compatible with the existing TB-29 array handling system.</li></ul>						
NEUTRALIZATION  Neutralization focuses on undersea weapons technologies to counter threat submarines by increasing the Probability of Kill (PK). The ultimate goals of Neutralization efforts are to develop reduced size advanced undersea weapons with revolutionary capabilities and to fill Sea Shield mission capability gaps and demonstrate transformational capabilities for ASW weapons.  The FY 2009 to FY 2010 funding decrease is due to the realignment of the Neutralization activity to the newly established Undersea Weaponry activity.  FY 2009 Accomplishments: All efforts, except those indicated as complete below, transfer from this activity to the new Undersea Weaponry Activity in FY 2010.  <ul style="list-style-type: none"><li>- Continued Lightweight Torpedo Technologies (LTT) integration of broadband and adjunct sensors for in-water data collection to result in a new dual-mode sensor guidance and control system for at-sea testing.</li><li>- Continued feasibility investigations under LTT to quantify adjunct sensor configurations and signal processing approaches to enable positive discrimination of artificial targets at standoff ranges. This feasibility investigation is expected to result in five (5) new patent applications.</li></ul>		20.377	0.000	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology	
B. Accomplishments/Planned Program (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for lightweight torpedo (LWT).</li><li>- Continued development and integration of adjunct sensors into a lightweight torpedo sensor and design signal processing and data fusion techniques to improve target classification in areas of high contact density.</li><li>- Continued in-water data collection for development of advanced counter countermeasure processing, weapon-to-weapon acoustic communication and a salvo vehicle intelligent controller.</li><li>- Continued LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 lightweight torpedo (LWT).</li><li>- Continued LTT feasibility investigations and selected geo-coordinate based navigation system technologies and connectivity methods (i.e. acoustic communications, fiber link) for future development of technologies for LWT demonstration).</li><li>- Continued data collection for LWT broadband and counter-countermeasures in the harsh shallow water environment of the Shore Bombardment Area site off the Southern California Off-Shore Range using an experimental test vehicle fitted with a broadband Mk 54 array.</li><li>- Continued feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range.</li><li>- Continued a high fidelity weapon frequency model development effort to parallel adjunct sensor developments and provide accurate synthetic data for algorithm design and measurement.</li><li>- Continued development of a high channel count LTT broadband transmitter.</li><li>- Continued development and integration of a total LTT system prototype in the Mk 54 torpedo form factor for at sea demonstrations.</li><li>- Continued development of a reduced size/weight CRAW for air deployment. This effort will include sensor, guidance and control, warhead, propulsion, and air frame integration tasks.</li><li>- Continued CRAW in water data collection to support development of guidance and control algorithms enabling an ASW offensive capability in the Common Very Lightweight Torpedo.</li><li>- Continued tests to support the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal.</li></ul>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Completed LTT advanced counter-countermeasure algorithm and tactics development for LWT.</li><li>- Completed LTT integration of broadband and adjunct sensors for in-water data collection to result in a new dual-mode sensor guidance and control system for at-sea testing.</li><li>- Completed feasibility investigations under LTT to quantify adjunct sensor configurations and signal processing approaches to enable positive discrimination of artificial targets at standoff ranges. This feasibility investigation is expected to result in five (5) new patent applications.</li><li>- Completed LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT.</li><li>- Completed development and integration of adjunct sensors into a lightweight torpedo sensor and design signal processing and data fusion techniques to improve target classification in areas of high contact density.</li><li>- Completed in-water data collection for development of advanced counter countermeasure processing, weapon-to-weapon acoustic communication and a salvo vehicle intelligent controller.</li><li>- Completed demonstration of LTT underwater acoustic communications capability to enable coordinated attack and net-centric connectivity.</li><li>- Completed demonstration of LTT weapon salvo capability utilizing behavior-based control.</li><li>- Initiated and completed LTT development, scale up and testing prototype components.</li><li>- Initiated demonstration of LTT underwater acoustic communications capability to enable coordinated attack and net-centric connectivity. (Transitioned from PE 0602747N)</li><li>- Initiated demonstration of LTT weapon salvo capability utilizing behavior-based control (Transitioned from PE 0602747N)</li><li>- Initiated development of an integrated LTT set-to-hit simulation capability to evaluate weapon performance gains to include robust representations of component technologies developed and demonstrated under the LTT project.</li><li>- Initiated design and development of an integrated LTT full system prototype consisting of hardware and software upgrades for a final at-sea demonstration to be conducted in FY 2010.</li><li>- Initiated in-water data collection on CRAW homing in presence of countermeasures.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
UNDERSEA WEAPONRY		0.000	13.492	7.046	0.000	7.046
<p>Undersea Weaponry focuses on the development of enabling technologies to counter threat submarines and surface vessels by increasing Probability of Kill (PK) and platform survivability. Weapon technology focus areas include: the Lightweight Torpedo Technologies (LTT) and the Compact Rapid Attack Weapon (CRAW) projects. The ultimate goal of this activity is to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, to accommodate unique payload limitations through the development of modular and reduced sized undersea weapons based on common technology enablers (where possible), and to provide improved submarine cuing/wide area search in deep and shallow water ocean areas while providing the capability to rapidly transition the submarine mission to engagement/neutralization.</p> <p>The FY 2009 to FY 2010 funding increase is due to the realignment of the Neutralization activity into this new activity. The FY 2010 to FY 2011 funding decrease is primarily due to the completion of the Future Naval Capability (FNC)- SHD-FY06-02 Lightweight Torpedo Technologies.</p> <p><i>FY 2010 Plans:</i></p> <p>The following efforts transferred to this activity from the FY 2009 Neutralization activity:</p> <ul style="list-style-type: none"><li>- Continue development of a reduced size/weight CRAW for air deployment. This effort will include sensor, guidance and control, warhead, propulsion, and air frame integration tasks.</li><li>- Continue CRAW in water data collection to support development of guidance and control algorithms enabling an ASW offensive capability in the Common Very Lightweight Torpedo.</li><li>- Continue tests to support the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal.</li><li>- Continue in-water data collection on CRAW homing in presence of countermeasures.</li><li>- Complete a high fidelity weapon frequency model development effort to parallel adjunct sensor developments and provide accurate synthetic data for algorithm design and measurement.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Complete LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 lightweight torpedo (LWT).</li><li>- Complete further development of advanced fusing technology for LWT started in FY09 as part of the LTT FNC project.</li><li>- Complete LTT feasibility investigations and selected geo-coordinate based navigation system technologies and connectivity methods (i.e. acoustic communications, fiber link) for future development of technologies for LWT demonstration).</li><li>- Complete data collection for LWT broadband and counter-countermeasures in the harsh shallow water environment of the Shore Bombardment Area site off the Southern California Off-Shore Range using an experimental test vehicle fitted with a broadband Mk 54 array.</li><li>- Complete feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range.</li><li>- Complete development of a high channel count LTT broadband transmitter.</li><li>- Complete development and integration of a total LTT system prototype in the Mk 54 torpedo form factor for at sea demonstrations.</li><li>- Complete development of an integrated LTT set-to-hit simulation capability to evaluate weapon performance gains to include robust representations of component technologies developed and demonstrated under the LTT project.</li><li>- Complete design and development of an integrated LTT full system prototype consisting of hardware and software upgrades for final at-sea demonstrations to be conducted in FY 2010.</li><li>- Initiate and complete at-sea demonstration and assessment of LTT full system prototype.</li><li>- Transition demonstrated Lightweight Torpedo Technologies to PE 0604610N (Lightweight Torpedo Development).</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all efforts of FY 10, less those noted as completed above.</li><li>- Continue development of a reduced size/weight CRAW for air deployment. This effort will include sensor, guidance and control, warhead, and mainframe integration tasks.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE		57.552	0.000	0.000	0.000	0.000
<p>Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable offboard systems with associated processing and robust, high-bandwidth communications links. The cornerstone of Wide Area ASW Surveillance is the ability to rapidly distribute sensors from air, surface and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked, multi-static operation, supported by passive/active signal processing with the objective of increased detection capabilities.</p> <p>The FY 2009 to FY 2010 funding decrease is due to the realignment of efforts in this activity to the newly established ASW Distributed Search; ASW Surveillance; and Performance Assessment activities respectively.</p> <p><i>FY 2009 Accomplishments:</i></p> <p>The following efforts transfer to the new ASW Distributed Search activity in FY 2010:</p> <p>- Continued development of DSP threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems.</p> <p>The following efforts transfer to the new ASW Surveillance activity in FY 2010:</p> <p>- Continued STT-Baseline advanced research efforts in the areas of advanced undersea sensors, communications, autonomy, and sensor data collection and analysis to support tracking algorithm and automated processing development.</p> <p>- Continued Deployable Autonomous Distributed System (DADS) deployability, survivability and classification performance improvement effort.</p> <p>- Continued testing of the Palantir (a non-acoustic surveillance system) sensor system.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603747N: Undersea Warfare Advanced Tech		PROJECT 2916: Undersea Warfare Advanced Technology		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued tactical test planning for the Palantir sensor.</li><li>- Continued DADS at-sea classification performance improvement testing.</li><li>- Continued at-sea testing of integrated STT submersibles and evaluate overall system performance.</li><li>- Continued the ODDCL effort focusing on the development of sensor and platform designs and key components compatible with a notional Concept of Operations.</li><li>- Continued development of a tactical area prototype system for PLUS.</li><li>- Initiated simulation test of the PLUS prototype system in preparation for at-sea experiments.</li><li>- Initiated analysis of data collected during the PLUS at-sea experiments.</li><li>- Initiated two at-sea experiments focused on increasing system persistence capabilities.</li><li>- Initiated DADS deployability, covert communications and survivability testing.</li><li>- Initiated system level design and integration for ODDCL.</li><li>- Initiated at-sea demonstrations of STT submersible with fully integrated sensor package.</li></ul> <p>The following efforts transfer to the new ASW Performance Assessment activity in FY 2010:</p> <ul style="list-style-type: none"><li>- Initiated test planning of source algorithms to be used to determine the optimal initial placement of uncontrolled drifting distributed systems.</li><li>- Initiated research effort aimed at the ideal placement and control of acoustic sources and drifting sensor systems.</li><li>- Initiated a research effort focusing on distributed system in-situational environmental characterization and system monitoring.</li><li>- Initiated a research effort to determine the placement of and follow-on control and pattern keeping of mobile sources and distributed sensor systems.</li></ul> <p>The following efforts complete; consequently they do not transfer or continue in FY 2010:</p> <ul style="list-style-type: none"><li>- Completed development of and demonstrate an advanced development model of a DWADS</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy							<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>			<b>R-1 ITEM NOMENCLATURE</b> PE 0603747N: <i>Undersea Warfare Advanced Tech</i>			<b>PROJECT</b> 2916: <i>Undersea Warfare Advanced Technology</i>					
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<p>System for surveillance of deep ocean submarine threats. This project transitions to the Advanced Development for Undersea Systems Program Office (IWS 5.0) and the ASW Cross Functional Team (N874). Funding to support the transition is in PE 0603561N Project 02033.</p> <ul style="list-style-type: none"> <li>- Completed development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas.</li> <li>- Completed integration and evaluation of STT tracking algorithms and automated processing.</li> </ul> <p>Acquisition Workforce Fund</p> <ul style="list-style-type: none"> <li>- Funded DoD Acquisition Workforce Fund.</li> </ul>											
Accomplishments/Planned Programs Subtotals						77.929	67.660	49.276	0.000	49.276	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0602747N: <i>UNDERSEA WARFARE APPLIED RESEARCH</i>	9.499	8.594	11.393	0.000	11.393	11.135	10.088	6.334	1.930	0.000	58.973
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> <p>Improve target detection, localization, and tracking and increase attack capabilities by providing the following capabilities:</p> <ul style="list-style-type: none"> <li>- Localization of 85% or more of enemy submarines in far forward or contested waters with false locations of less than 10% of total calls.</li> <li>- Effective cueing of an attack from a distance of up to 200nm.</li> <li>- Improvement of the Lightweight Torpedo (Mk 54). Specific improvements are classified.</li> <li>- Extending deep water active distributed system lifetime to a few months with a probability of detection (Pd) of 90% within 4 hours (field configuration) or 90% per crossing (barrier configuration), with a False Alarm Rate (FAR) of no more than 4/day.</li> </ul>											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603747N: <i>Undersea Warfare Advanced Tech</i>	<b>PROJECT</b> 2916: <i>Undersea Warfare Advanced Technology</i>
<p>- Delivery from a Vertical Takeoff Unmanned Air Vehicle (VTUAV) and/or a long-range, high-speed Unmanned Air Vehicle (UAV) a compact undersea weapon capable of a high Probability of Kill (PK) given precise target localization.</p> <p>- Detection and localization performance with a single-line vector sensor array nominally equivalent or superior to that of two coherently processed TB-29A arrays. Acquisition costs to be competitive with the cost of a current TB-29A and at least 30% less than the cost of two arrays. Sensor and telemetry packaging will be adequate to achieve neutral buoyancy in an existing TB-29A form factor with array power efficiency greater than 75%. Array handling will be compatible with the existing TB-29 handling system.</p> <p>Increase sensor to shooter performance and the effective lifetime of distributed ASW search systems by:</p> <ul style="list-style-type: none"> <li>- Achieving a drifting active distributed system lifetime of at least two days in areas of tactical significance while maintaining required system performance with a minimum number of sensor nodes.</li> <li>- Maintaining an effective lifetime of a month for mobile active distributed systems when subjected to the action of eddies from a major ocean current.</li> <li>- Predicting reseed 6 hours before performance degrades.</li> <li>- Holding the Area of Uncertainty (AOU) to no larger than 10 nm<sup>2</sup> for an hour after initial detection through the control of the coherent sources.</li> </ul> <p>Through a combination of better Anti-Submarine Warfare (ASW) command-level training and improved operator training provide the following:</p> <ul style="list-style-type: none"> <li>- Improve the ability of active sonar operators to detect targets and reject potential false alarms compared to current simulation based training.</li> <li>- Increase Pd by 50%.</li> <li>- Provide a decrease in FAR by a factor of two.</li> <li>- Provide a reduction in the probability of a hit on a High Value Unit (HVV) by a factor of two.</li> <li>- Improve the ability of the ASW Commander to position assets to increase coverage, reduce active system interference and deal effectively with competing missions.</li> <li>- Reduce training cost by greater than 80% and increase the frequency of training opportunities by greater than 600% relative to live training.</li> </ul>		

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603747N: <i>Undersea Warfare Advanced Tech</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	2.394	5.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23.949
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Underwater Explosives and Warhead Research <i>FY 2010 Plans:</i> This effort supports Underwater Explosives and Warhead Research.							0.000	2.988			
Congressional Add: ASW Research Prog - Cong <i>FY 2010 Plans:</i> This effort supports ASW Research.							0.000	2.988			
Congressional Add: Theater Undersea Warfare Initiative <i>FY 2009 Accomplishments:</i> This effort supported the Theater Undersea Warfare Initiative (TUSWI) by applying capabilities developed in prior years as a tactical decision aid (TDA) for the Theater ASW Commander to the problem of training the Theater ASW Commander.							2.394	0.000			
Congressional Adds Subtotals							2.394	5.976			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
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<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b> N/A		
<b><u>D. Acquisition Strategy</u></b> N/A		
<b><u>E. Performance Metrics</u></b> Congressional Interest Items not included in other Projects.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603758N: Navy Warfighting Exp & Demo							
COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	65.208	52.373	53.177	0.000	53.177	63.292	68.497	69.861	71.533	Continuing	Continuing
2918: Navy Warfighting Experiments and Demo	59.025	52.373	53.177	0.000	53.177	63.292	68.497	69.861	71.533	Continuing	Continuing
9999: Congressional Adds	6.183	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.183
A. Mission Description and Budget Item Justification											
<p>This Program Element (PE) addresses the development of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototype for warfighter experimentation during laboratory and operational demonstrations, Fleet Battle Experiments (FBE), Limited Objective Experiments (LOEs) and Sea Trial Exercises. The key aspects of this PE are divided into four areas: (1) SwampWorks develops and demonstrates newly invented or recently discovered technologies that address emergent and enduring operational problems in an accelerated timeframe; (2) Naval Warfare Experimentation develops prototypes of recent technology breakthroughs and provides them to the warfighter for experimentation during FBEs, LOEs or Sea Trials; (3) Tech Solutions develops rapid response science and technology prototypes addressing Fleet/Force needs identified by Sailors and Marines at the deckplate level; and (4) Operations Analysis provides the Navy and Marine Corps the means to identify capability needs that can be addressed with science and technology solutions.</p>											
<p>Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.</p>											

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy		PE 0603758N: Navy Warfighting Exp & Demo			
BA 3: Advanced Technology Development (ATD)					
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	66.138	52.643	0.000	0.000	0.000
Current President's Budget	65.208	52.373	53.177	0.000	53.177
Total Adjustments	-0.930	-0.270	53.177	0.000	53.177
• Congressional General Reductions		-0.218			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.052			
• Congressional Adds		0.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.282	0.000			
• SBIR/STTR Transfer	-1.212	0.000			
• Program Adjustments	0.000	0.000	53.177	0.000	53.177
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds				FY 2009	FY 2010
Congressional Add: Immersive Naval Officer Training Systems				2.992	0.000
Congressional Add: Portable Launch and Recovery System for UAV Operat				3.191	0.000
Congressional Add Subtotals for Project: 9999				6.183	0.000
Congressional Add Totals for all Projects				6.183	0.000
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603758N: <i>Navy Warfighting Exp &amp; Demo</i>				<b>PROJECT</b> 2918: <i>Navy Warfighting Experiments and Demo</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2918: <i>Navy Warfighting Experiments and Demo</i>	59.025	52.373	53.177	0.000	53.177	63.292	68.497	69.861	71.533	Continuing	Continuing
<b>A. Mission Description and Budget Item Justification</b> This project focuses on the development of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototype for warfighter experimentation during laboratory and operational demonstrations, FBE, LOEs and Sea Trial Exercises.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
NAVAL WARFARE EXPERIMENTATION						34.838	26.975	19.704	0.000	19.704	
<p>The objective of this project is to capitalize on recent technology breakthroughs to develop prototypes quickly and provide them to the warfighter for experimentation during laboratory and operational demonstrations, Sea Trials or LOEs. Current efforts include experimentation with Electronics Warfare (EW) technologies, development of test simulation technology for ship affordability, technology to advance riverine warfare operations, development and demonstration of real time situational awareness technologies, fuel cell power for unmanned air vehicles, and technology investigation studies.</p> <p>The funding level decrease in FY 2010 and FY 2011 is due to completion of additional experimentation initiatives funded initially in FY 2009.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"> <li>- Continued concept based technology program efforts.</li> <li>- Continued experimentation efforts with technologies developed in SwampWorks/Tech Solutions.</li> <li>- Continued to identify promising technology breakthroughs that can be prototyped and delivered to the warfighter for experimentation.</li> <li>- Continued development and demonstration of real time situational awareness technologies.</li> </ul>											

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603758N: Navy Warfighting Exp & Demo		PROJECT 2918: Navy Warfighting Experiments and Demo		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued Ship Affordability program to examine ship designs and construction processes and develop technologies that can significantly reduce the costs to conceive, design and construct naval ships.</li><li>- Continued development of Autonomous Underwater Vehicle (AUV) large sensor network for persistent pervasive surveillance.</li><li>- Continued DDG-51 fuel efficient power &amp; propulsion demonstrator effort.</li><li>- Initiated and completed Maritime Domain Awareness (MDA) augmentation.</li><li>- Initiated and completed effort to develop and demonstrate an integrated, affordable and minimally manned warfighting sensor capability to provide adaptive persistent surveillance leading to Operational Adaptation by Naval forces in defeating the Asymmetric and Irregular Warfare threat.</li><li>- Initiated effort to develop and demonstrate integrated intelligence, surveillance, observation, and navigation technologies into a common operation picture accessible throughout the U.S. Government.</li><li>- Initiated effort to demonstrate shipboard high temperature degaussing technologies.</li><li>- Initiated development of network attack option models for near real time forensics and social network mapping.</li><li>- Initiated at sea laser technology experimentation.</li></ul> <p>Acquisition Workforce Fund</p> <ul style="list-style-type: none"><li>- Funded DoD Acquisition Workforce Fund.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all FY 2009 efforts, less those noted as complete above.</li><li>- Complete development of AUV large sensor network for persistent pervasive surveillance.</li><li>- Complete at sea laser technology experimentation.</li><li>- Complete effort to demonstrate shipboard high temperature degaussing technologies.</li><li>- Initiate and complete advanced coupling for integrated in line high speed generator energy storage effort.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603758N: Navy Warfighting Exp & Demo		PROJECT 2918: Navy Warfighting Experiments and Demo		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate and complete experiments to demonstrate shipboard high efficiency solid state lighting technologies.</li><li>- Initiate technology experimentation for Total Ownership Cost (TOC) reduction.</li></ul> <p><i>FY 2011 Base Plans:</i></p> <ul style="list-style-type: none"><li>- Continue all FY 2010 efforts, less those noted as complete above.</li><li>- Complete development of network attack option models for near real time forensics and social network mapping.</li><li>- Initiate efforts to develop and demonstrate technologies to meet current or emerging operational needs.</li></ul>						
OPERATIONS ANALYSIS  The objective of this project is to provide operational analysis through studies, analyses, gaming and experimentation to identify Navy and Marine Corps capability needs that can be addressed with Science and Technology (S&T) solutions. The effort includes core analysis of S&T programs, military utility / capability gaps analyses, war gaming and fleet experimentation analysis. Recent work includes development and execution of an MDA war game as part of an MDA Simulation Experiment (SIMEX); participation in SIMEX data collection and analysis; support of Joint Capabilities Integration Development System capabilities; development of a Code of Best Practices for Operational Experimentation; analytical, strategic planning, and wargaming support of Innovative Naval Prototype efforts; organizing and conducting workshops and symposia that increase innovative outreach; fleet operational readiness assessments; and, Red Team conceptual analysis.  <i>FY 2009 Accomplishments:</i> <ul style="list-style-type: none"><li>- Continued to conduct Military Utility Analyses of Future Naval Capability technologies.</li><li>- Continued to conduct capability gaps analyses to identify areas that can be addressed with products from the S&amp;T portfolio.</li></ul>		2.797	2.706	2.864	0.000	2.864

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603758N: Navy Warfighting Exp & Demo		PROJECT 2918: Navy Warfighting Experiments and Demo		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>- Continued to conduct war games focused on technical issues for S&amp;T transitions to acquisition and the fleet.</p> <p><i>FY 2010 Plans:</i></p> <p>- Continue all FY 2009 efforts.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all FY 2010 efforts.</p>						
SWAMPWORKS		13.991	13.355	21.062	0.000	21.062
<p>SwampWorks seeks to develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. Some of these technologies may end up in the hands of the warfighter for experimentation, or may culminate in a significant exercise that demonstrates capability then transitions into the Acquisition Program of Record (POR). Examples of recent successes are the half-length torpedo which led to the development of the SwampWorks Broadband Sonar and transitioned to the Mk 48 Advanced Capability program and the Aircraft Carrier Situational Awareness System, which will be incorporated into a POR. Examples of current efforts include a high resolution sonar for the new lightweight torpedo, energy storage and reduced energy consumption technologies, coherent stand-in jammer, full ship shock test simulation, effective active acoustics simulation, and technology investigation studies.</p> <p>The increase in funding from FY 2010 to FY 2011 is due to an increased emphasis in developing and demonstrating technologies that address emergent and enduring operational problems in an accelerated timeframe. Among the efforts pursued during FY 2011 are advanced development of DC power components and systems for shipboard applications; development of advanced unmanned systems; development of advanced technologies for the new generation of DDG-51; increased emphasis on electronic warfare, reduction of Total Ownership Costs (TOC), and autonomy capabilities; and rapid development of advanced technologies that directly support Navy priorities due to shifting theatres of operation.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603758N: Navy Warfighting Exp & Demo		PROJECT 2918: Navy Warfighting Experiments and Demo		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Continued to identify enduring and emergent operational barriers identified by naval leadership and responded with relevant technology developments and demonstrations.</li><li>- Continued novel heavy fuel propulsion system development.</li><li>- Completed development of new technologies that are responsive to Taskforce Antisubmarine Warfare.</li><li>- Completed development of technologies that reduce energy consumption losses during recent operations.</li><li>- Initiated and completed development of electronic warfare technologies that are responsive to fleet needs to counter emerging threats.</li><li>- Initiated and completed flight deck non-skid project.</li><li>- Initiated disruptive commercial technology studies at varied military, government, and educational institutions.</li><li>- Initiated thermal management project.</li><li>- Initiated underwater communication technology development project.</li></ul>						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all FY 2009 efforts, less those noted as complete above.</li><li>- Complete thermal management project.</li><li>- Complete underwater communication technology development project.</li><li>- Initiate exploration of technologies to address emergent EW threats for surface and air platforms.</li><li>- Initiate high risk/high payoff projects to explore significant reduction in TOC.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all FY 2010 efforts, less those noted as complete above.</li><li>- Initiate efforts to develop technologies to meet current or emerging operational needs.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603758N: Navy Warfighting Exp & Demo		PROJECT 2918: Navy Warfighting Experiments and Demo		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Initiate investment in submarine control surface technologies to provide improved maneuvering capabilities and drastically reduce TOC. Programs include but are not limited to the VA class, and Ohio Replacement programs.</li><li>- Initiate investment in advanced electronic warfare technologies; projects are expected to be classified at a higher level.</li><li>- Initiate investments in technologies to reduce TOC for the new generation of DDG-51 vessels.</li><li>- Initiate investment in technologies to improve the new DDG-51, with specific focus on advanced propulsion, and power generation and distribution.</li></ul>						
TECH SOLUTIONS  Tech Solutions develops rapid response S&T solutions to immediate Fleet/Force needs identified by individual warfighters at the deckplate level. Sailors, Marines and Science Advisors submit their issues throughout the year via the Tech Solutions website, email, phone, or chain of command. Projects are initiated as requests come in and are generally completed in approximately twelve to eighteen months.  The funding increase in FY 2010 and out is due to the initiation and ramping up of a series of new science and technology programs focused on anti-terrorism and force protection as identified by Science Advisors and the Fleet/Force.  FY 2009 Accomplishments: <ul style="list-style-type: none"><li>- Initiated development of projects that provide solutions to problems identified by Science Advisors and the Fleet/Force to address emergent critical needs and developed, demonstrated and delivered technical solutions.</li></ul> FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all FY 2009 efforts.</li></ul>		7.399	9.337	9.547	0.000	9.547

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy				<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0603758N: <i>Navy Warfighting Exp &amp; Demo</i>		<b>PROJECT</b> 2918: <i>Navy Warfighting Experiments and Demo</i>				
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>								
				<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<p>- Initiate development of projects that provide solutions to problems identified by Science Advisors and the Fleet/Force to address emergent critical needs and develop, demonstrate and deliver technical solutions.</p> <p><i>FY 2011 Base Plans:</i></p> <p>- Continue all FY 2010 efforts.</p> <p>- Initiate development of projects that provide solutions to problems identified by Science Advisors and the Fleet/Force to address emergent critical needs and develop, demonstrate and deliver technical solutions.</p>								
Accomplishments/Planned Programs Subtotals				59.025	52.373	53.177	0.000	53.177
<b>C. Other Program Funding Summary (\$ in Millions)</b>								
N/A								
<b>D. Acquisition Strategy</b>								
N/A								
<b>E. Performance Metrics</b>								
<p>Overall metric goals are to transition the 6.3 advanced technology projects into acquisition programs of record, demonstrate successful technologies to enable new operational concepts, and enable the production of technology products such as proofs of concept and manufacturing packages. The performance of the work funded in this PE is reviewed at several levels to ensure that the investment is relevant and productive. At the macroscopic level, the investment is coordinated with Navy Warfare Development Command and Commander, Fleet Forces Command to address the goals and objectives identified for Sea Trials and LOEs. At the microscopic level, the work funded in this PE is reviewed periodically by the Program Manager to ensure the investment is meeting the goals defined for each project. This review includes feedback collected from the warfighter community on all Sea Trials and LOEs to support the Program Manager's assessment of the value and relevance of each investment. Furthermore, the entire program is reviewed yearly by the Chief of Naval Research.</p>								

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603758N: <i>Navy Warfighting Exp &amp; Demo</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
9999: <i>Congressional Adds</i>	6.183	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.183
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Items not included in other Projects.											
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
							<b>FY 2009</b>	<b>FY 2010</b>			
Congressional Add: Immersive Naval Officer Training Systems							2.992	0.000			
<i>FY 2009 Accomplishments:</i> This effort provided the Navy with the capability to create a new training environment that exposes new officers to life-like situations and stimuli that will prepare them for real world combat and missions in a safe and effective learning environment.											
Congressional Add: Portable Launch and Recovery System for UAV Operat							3.191	0.000			
<i>FY 2009 Accomplishments:</i> This effort provided the capability for long-endurance unmanned aerial vehicles to operate from small vessels in support of Navy special warfare teams.											
Congressional Adds Subtotals							6.183	0.000			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy		<b>DATE:</b> February 2010
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603758N: <i>Navy Warfighting Exp &amp; Demo</i>	<b>PROJECT</b> 9999: <i>Congressional Adds</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> Congressional Add.		

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**Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy** **DATE:** February 2010

<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0603782N: <i>Mine and Expeditionary Warfare Advanced Technology</i>
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COST (\$ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	34.570	30.256	21.941	0.000	21.941	9.135	16.357	21.204	25.800	Continuing	Continuing
2917: <i>Shallow Water MCM Demos</i>	33.373	28.663	21.941	0.000	21.941	9.135	16.357	21.204	25.800	Continuing	Continuing
9999: <i>Congressional Adds</i>	1.197	1.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.109

## A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE primarily develops and demonstrates prototype Mine Countermeasures (MCM) and Expeditionary Warfare system components that support capabilities enabling Naval Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littoral battlespace. Real world operations have demonstrated the requirement to quickly counter the mine threat. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. This program supports the advanced development and integration of sensors, processing, warheads and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the MCM-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship To Objective Maneuver (STOM) key transformational capability within Sea Strike.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy				DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		PE 0603782N: Mine and Expeditionary Warfare Advanced Technology			
B. Program Change Summary (\$ in Millions)					
	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	34.501	28.782	0.000	0.000	0.000
Current President's Budget	34.570	30.256	21.941	0.000	21.941
Total Adjustments	0.069	1.474	21.941	0.000	21.941
• Congressional General Reductions		-0.126			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		1.600			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.798	0.000			
• SBIR/STTR Transfer	-0.729	0.000			
• Program Adjustments	0.000	0.000	21.941	0.000	21.941
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: JEOD DRIVER SITUATIONAL AWARENESS SYS					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Technical: Not applicable.					
Schedule: Not applicable.					
FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.					

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603782N: <i>Mine and Expeditionary Warfare Advanced Technology</i>				<b>PROJECT</b> 2917: <i>Shallow Water MCM Demos</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
2917: <i>Shallow Water MCM Demos</i>	33.373	28.663	21.941	0.000	21.941	9.135	16.357	21.204	25.800	Continuing	Continuing

## A. Mission Description and Budget Item Justification

This project primarily develops and demonstrates prototype MCM technologies that support a range of capabilities enabling Naval Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics. Recent operations have demonstrated the requirement to counter the projected mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water to the inland objective. This project supports the advanced development and integration of sensors, processing, warheads and delivery vehicles. It supports the MCM-related FNC ECs.

## B. Accomplishments/Planned Program (\$ in Millions)

	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>
<b>MINE/OBSTACLE DETECTION</b>	19.497	19.278	18.423	0.000	18.423
<p>This activity focuses on developing and demonstrating technologies that support detection, classification, identification and multi-sensor data fusion of mine and obstacle data to speed tactical timelines and increase operator standoff. Efforts include: electro-optic sensors/systems to enable Unmanned Aerial Vehicle (UAV) rapid minefield reconnaissance and precise mineline location from Very Shallow Water (VSW) through the BZ; sensors/systems to enable cooperating Unmanned Underwater Vehicles (UUVs) to perform wide-area reconnaissance and assault lane reconnaissance/preparation from shallow water through the SZ; sensor development for detection and classification of buried mines; technologies for MCM Mission Modules for the new Littoral Combat Ships (LCS); and sensor data fusion to enable a theater mine warfare common operating picture and own ship protection. This activity supports the development and transition of technologies for the MCM-related FNCs.</p> <p>This S&amp;T investment supports the Joint Requirements Oversight Council of the Joint Chiefs of Staff and Office of the Chief of Naval Operations (OPNAV) validated requirements for MCM. This S&amp;T investment of mine and obstacle detection provides critical S&amp;T transitions to the Mine Warfare Mission</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010			
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603782N: Mine and Expeditionary Warfare Advanced Technology		PROJECT 2917: Shallow Water MCM Demos		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<p>package of the Navy's new LCS. This investment in MCM S&amp;T is reported as part of OPNAV's annual report to Congress in the MCM Certification Plan. This plan is reviewed and approved by the Office of the Secretary of Defense, and any deviations in ONR's reported S&amp;T funding for MCM throughout the Future Years Defense Plan must be reported and justified through Navy and OSD. Further, the MCM S&amp;T investment plan structure is reviewed and authorized by the Navy's Technology Oversight Group that approves ECs, their supporting products, and funding profiles.</p> <p><i>FY 2009 Accomplishments:</i></p> <ul style="list-style-type: none"><li>- Continued advanced processing development for Low Frequency Broad Band to enable rapid detection, classification and identification of buried sea mines.</li><li>- Continued development of multi-platform fusion from high-resolution mine hunting systems (e.g. AN/ AQS-20) for improved mine detection and avoidance.</li><li>- Continued development of Tactical Unmanned Aerial Vehicle (TUAV)-based SZ/BZ buried minefield detection capability.</li><li>- Continued multiple unmanned system MCM data fusion techniques for reduction in false alarms and reduction in tactical timelines.</li><li>- Continued technology development, integration and early demonstration planning for MCM Mission Module systems for Advanced Flight LCS.</li><li>- Continued technology development for multiple UUV Undersea Cooperative Cueing and Intervention in support of MCM operations.</li><li>- Complete buried mine sensing identification processing development.</li><li>- Complete development and final flight testing of ROAR system against surface laid mines and obstacles.</li><li>- Initiate field testing of prototype airborne buried mine sensors.</li><li>- Initiate integration of buried mine sensors onto airborne platform and begin flight testing.</li><li>- Initiate planning for assault breaching systems exercise involving the mine detection systems.</li></ul> <p>Acquisition Workforce Fund</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603782N: Mine and Expeditionary Warfare Advanced Technology		PROJECT 2917: Shallow Water MCM Demos		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Funded DoD Acquisition Workforce Fund.						
FY 2010 Plans: <ul style="list-style-type: none"><li>- Continue all FY 2009 efforts, less those noted as completed above.</li><li>- Complete development of Tactical Unmanned Aerial Vehicle (TUAV)-based SZ/BZ buried minefield detection capability.</li><li>- Complete field testing of prototype airborne buried mine sensors.</li><li>- Complete integration of buried mine sensors onto airborne platform and begin flight testing.</li><li>- Complete technology development, integration and early demonstration planning for MCM Mission Module systems for Advanced Flight LCS.</li><li>- Initiate development of iPUMA/Synthetic Aperture Sonar system to provide the first non marine mammal based mine detection and classification capability for confined or highly obstructed areas.</li><li>- Initiate development of Small Acoustic Color/Imaging Sonar system to provide the first non marine mammal detection, classification and identification capability for very shallow water (VSW) and reduce the false-alarm rate by x20 for all VSW mine threats.</li><li>- Initiate development of Long Range Low Frequency Broadband (LRLFBB) Sonar to significantly increase the minehunting area coverage rate.</li><li>- Initiate Phase 2 of Advanced Mission Module Technology Development.</li></ul>						
FY 2011 Base Plans: <ul style="list-style-type: none"><li>- Continue all FY 2010 efforts, less those noted as completed above.</li><li>- Complete planning and demonstration for combined assault breaching systems exercise involving the mine detection systems.</li><li>- Complete technology development for multiple UUV/USV Undersea Cooperative Cueing and Intervention in support of MCM operations.</li><li>- Complete Phase 2 of Advanced Mission Module Technology Development with a final demonstration.</li><li>- Complete development of multi-platform fusion of high-resolution mine hunting systems (e.g. AN/AQS-20) for improved mine detection and avoidance.</li></ul>						

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603782N: Mine and Expeditionary Warfare Advanced Technology		PROJECT 2917: Shallow Water MCM Demos		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete multiple unmanned system MCM data fusion techniques for reduction in false alarms and reduction in tactical timelines.						
MINE/OBSTACLE NEUTRALIZATION  Mine and Obstacle Neutralization activity is focused on improving the capability to neutralize mines and obstacles from deep water through the beach exit zone. Efforts include the development of technologies for: stand-off breaching of mines and obstacles in the SZ/BZ; minesweeping and jamming of sea mines; and Autonomous Underwater Vehicle (AUV) neutralization of sea mines. Stand-off breaching efforts demonstrate a mine and obstacle breaching capability that is enabled by precision weapon guidance and Intelligence, Surveillance, and Reconnaissance (ISR), and delivered by Naval Tactical Aircraft (TACAIR) and USAF Bombers. Tactical performance of existing unitary bombs is being demonstrated. Other efforts will demonstrate a tactical countermine dart and dispenser concept. The minesweeping effort develops a mission package for deployment on Unmanned Surface Vehicles (USVs). Also, efforts will focus on improving an existing breaching weapon fuze and developing a precision assault lane marking navigation capability. This activity supports the development and transition of technologies for the MCM-related FNC ECs.  The investment reduction in FY 2010 reflects the completion and transition of major programs/projects during FY 2010. The investment reduction in FY 2011 reflects the completion and transition of major programs/projects during FY 2011.  FY 2009 Accomplishments: - Continued development of an autonomous mine neutralization system for VSW MCM. - Continued development of advanced Mine Warfare Mission module capabilities in support of the LCS Mine Warfare mission. - Continued development effort, to extend effectiveness of unitary warheads to greater depths and initiated planning of flight demo with Naval Special Clearance Team 1.		13.876	9.385	3.518	0.000	3.518

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy				DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 1319: Research, Development, Test & Evaluation, Navy BA 3: Advanced Technology Development (ATD)		R-1 ITEM NOMENCLATURE PE 0603782N: Mine and Expeditionary Warfare Advanced Technology		PROJECT 2917: Shallow Water MCM Demos		
B. Accomplishments/Planned Program (\$ in Millions)						
		FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
<ul style="list-style-type: none"><li>- Continued technology development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking.</li><li>- Continued development of an AUV system for neutralization of littoral mines.</li><li>- Initiate planning/preparation for flight demonstration of the JDAM Assault Breaching System (JABS) with tactical mines in very shallow water.</li><li>- Initiate planning for assault breaching systems exercise involving the unitary warheads, precision navigation and lane marking.</li></ul> <p>FY 2010 Plans:</p> <ul style="list-style-type: none"><li>- Continue all FY 2009 efforts.</li><li>- Complete development effort to extend effectiveness of unitary warheads to greater depths and initiated planning of flight demo with Naval Special Clearance Team 1.</li><li>- Complete technology development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking.</li><li>- Complete flight demonstration of the JDAM Assault Breaching System (JABS) with tactical mines in very shallow water.</li><li>- Complete development of an autonomous mine neutralization system for VSW MCM.</li><li>- Complete development of advanced Mine Warfare Mission module capabilities in support of the LCS Mine Warfare mission.</li><li>- Initiate development of autonomous behaviors to improve neutralization efficiency of littoral sea mines.</li><li>- Initiate Phase 2 of Advanced Mission Module Technology Development.</li></ul> <p>FY 2011 Base Plans:</p> <ul style="list-style-type: none"><li>- Continue all FY 2010 efforts, less those noted as completed above.</li><li>- Complete assault breaching systems exercise involving the unitary warheads, precision navigation and lane marking.</li><li>- Complete development of AUV system/technologies for neutralization of littoral sea mines.</li></ul>						

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy							<b>DATE:</b> February 2010				
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>			<b>R-1 ITEM NOMENCLATURE</b> PE 0603782N: <i>Mine and Expeditionary Warfare Advanced Technology</i>			<b>PROJECT</b> 2917: <i>Shallow Water MCM Demos</i>					
<b>B. Accomplishments/Planned Program (\$ in Millions)</b>											
						<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	
<ul style="list-style-type: none"> <li>- Complete development of autonomous behaviors to improve neutralization efficiency of littoral sea mines.</li> <li>- Complete Phase 2 of Advanced Mission Module Technology Development with a final demonstration.</li> <li>- Initiate demonstration of autonomous neutralization of littoral sea mines.</li> </ul>											
Accomplishments/Planned Programs Subtotals						33.373	28.663	21.941	0.000	21.941	
<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2009</b>	<b>FY 2010</b>	<b>FY 2011 Base</b>	<b>FY 2011 OCO</b>	<b>FY 2011 Total</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0602782N: <i>MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH</i>	15.934	11.308	6.951	0.000	6.951	2.046	1.257	0.505	0.000	0.000	38.001
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> The overall metrics of this advanced technology program are the development of technologies supporting the Mine and Expeditionary Warfare challenges of reducing the MCM tactical timeline from months to days and eliminating the need for Navy divers and manned equipment to enter minefields. Another important metric is the scheduled transition of 6.3 advanced technology projects from the FNCs program into Navy and Marine Corps acquisition programs at agreed upon Technology Readiness Levels. Technology-specific metrics include: Mine warfare data fusion capabilities yielding a 10%-25% reduction in time and risk to mine hunting activities; Mine hunting sensors - Probability of Detection = 95%, Probability of Identification of Proud Mines = 90%, Probability of Classification of Buried Mines = 80%; Unmanned Systems for MCM sized for inclusion in the Littoral Combat Ship Mine Warfare Mission Package; MCM sensors sized, packaged and capable of 12 hour missions with a search rate greater than .05 square nautical mines per hour; Mine sweeping: Modular magnetic and acoustic influence sweeping systems packaged for deployment from Unmanned Surface Vehicles; Minesweeping single sortie coverage > 9.4 square nautical miles at 20 nautical miles per hour during a 4 hour mission up to Sea State 3; Surface-laid mine and obstacle breaching capability > 90% in the Beach Zone (BZ) using unitary warheads, and > 80% in the Surf Zone (SZ).											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2011 Navy								<b>DATE:</b> February 2010												
<b>APPROPRIATION/BUDGET ACTIVITY</b> 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0603782N: <i>Mine and Expeditionary Warfare Advanced Technology</i>				<b>PROJECT</b> 9999: <i>Congressional Adds</i>												
<b>COST (\$ in Millions)</b>	<b>FY 2009 Actual</b>	<b>FY 2010 Estimate</b>	<b>FY 2011 Base Estimate</b>	<b>FY 2011 OCO Estimate</b>	<b>FY 2011 Total Estimate</b>	<b>FY 2012 Estimate</b>	<b>FY 2013 Estimate</b>	<b>FY 2014 Estimate</b>	<b>FY 2015 Estimate</b>	<b>Cost To Complete</b>	<b>Total Cost</b>									
9999: <i>Congressional Adds</i>	1.197	1.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.109									
<p><b><u>A. Mission Description and Budget Item Justification</u></b>  Congressional Interest Items not included in other Projects.</p> <p><b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b></p> <table border="1" style="width:100%; border-collapse: collapse; margin-top: 20px;"> <tr> <td style="width:60%;"></td> <td style="width:20%; text-align: center;"><b>FY 2009</b></td> <td style="width:20%; text-align: center;"><b>FY 2010</b></td> </tr> <tr> <td> Congressional Add: JEOD DRIVER SITUATIONAL AWARENESS SYS   <i>FY 2009 Accomplishments:</i>  This effort supported the development of a self-contained, rugged, waterproof, and portable device capable of providing critical intelligence and essential technical information for use by the Navy and other government organizations responsible for protecting the nation's seaports and maritime operations.   <i>FY 2010 Plans:</i>  Continues support of Joint Explosive Ordinance Disposal Diver Situational Awareness System research. </td> <td align="center" style="vertical-align: top;">1.197</td> <td align="center" style="vertical-align: top;">1.593</td> </tr> <tr> <td align="right">Congressional Adds Subtotals</td> <td align="center">1.197</td> <td align="center">1.593</td> </tr> </table>													<b>FY 2009</b>	<b>FY 2010</b>	Congressional Add: JEOD DRIVER SITUATIONAL AWARENESS SYS  <i>FY 2009 Accomplishments:</i> This effort supported the development of a self-contained, rugged, waterproof, and portable device capable of providing critical intelligence and essential technical information for use by the Navy and other government organizations responsible for protecting the nation's seaports and maritime operations.  <i>FY 2010 Plans:</i> Continues support of Joint Explosive Ordinance Disposal Diver Situational Awareness System research.	1.197	1.593	Congressional Adds Subtotals	1.197	1.593
	<b>FY 2009</b>	<b>FY 2010</b>																		
Congressional Add: JEOD DRIVER SITUATIONAL AWARENESS SYS  <i>FY 2009 Accomplishments:</i> This effort supported the development of a self-contained, rugged, waterproof, and portable device capable of providing critical intelligence and essential technical information for use by the Navy and other government organizations responsible for protecting the nation's seaports and maritime operations.  <i>FY 2010 Plans:</i> Continues support of Joint Explosive Ordinance Disposal Diver Situational Awareness System research.	1.197	1.593																		
Congressional Adds Subtotals	1.197	1.593																		
<p><b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>  N/A</p> <p><b><u>D. Acquisition Strategy</u></b>  N/A</p>																				

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Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: <i>Research, Development, Test &amp; Evaluation, Navy</i> BA 3: <i>Advanced Technology Development (ATD)</i>	R-1 ITEM NOMENCLATURE PE 0603782N: <i>Mine and Expeditionary Warfare Advanced Technology</i>	PROJECT 9999: <i>Congressional Adds</i>
<b>E. Performance Metrics</b> Congressional Interest Items not included in other Projects.		